DEPARTMENT OF THE ARMY TECHNICAL MANUAL

DEPARTMENT OF THE AIR FORCE TECHNICAL ORDER

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# FIELD AND DEPOT MAINTENANCE

# RADIO SETS AN/GRC-26A AN/GRC-26B AND AN/GRC-26C

*DEPARTMENTS OF THE ARMY AND THE AIR FORCE*

*MARCH 1959*

AGO 4787A—Mar

## WARNING

### DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT

Be careful when working on the 115-volt ac line connections. Serious injury or death may result from contact with these terminals.

### DON'T TAKE CHANCES!

### AN EXTREMELY DANGEROUS VOLTAGE (2,500 VOLTS) EXISTS IN RADIO TRANSMITTER BC–610–(*)

When the transmitter is operating, keep away from all antenna connections and the antenna tuning unit. Extremely high current radio-frequency energy exists at those points.

Do not add gasoline to the vehicle fuel tank or the fuel tank of the power unit while transmitting. Radio-frequency voltage on the chassis of the vehicle may cause a spark resulting in an explosion. Turn off the radio transmitter and the power unit and *keep them off* until refueling is finished. To prevent explosions caused by static electricity, *always* connect the fuel container to the fuel tank before pouring gasoline from container to tank. *Do not smoke* during refueling operations.

TECHNICAL MANUAL
No. 11–5820–202–35
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DEPARTMENTS OF THE ARMY
AND THE AIR FORCE

WASHINGTON 25, D. C., *17 March 1959*

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# RADIO SETS AN/GRC–26A, AN/GRC–26B, AND AN/GRC–26C


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* This manual, together with TM 11–5820–202–10, 7 January 1959, and TM 11–5820–202–20, 24 December 1958, supersedes TM 11–264A, 6 January 1953, including C 1, 19 May 1954; C 2, 27 September 1954; C 3, 27 October 1955; C 4, 1 March 1956; C 5, 26 April 1956; and C 6, 29 May 1958.

# CHAPTER 1
# INTRODUCTION

## 1. Scope

*a.* These instructions are for the guidance of personnel performing field and depot maintenance on Radio Sets AN/GRC–26A, AN/GRC–26B, and AN/GRC–26C.

*b.* The complete manual for this equipment includes two other publications:

TM 11–5820–202–10, Radio Sets AN/GRC–26A, AN/GRC–26B, and AN/GRC–26C, Operator's Manual.

TM 11–5820–202–20, Radio Sets AN/GRC–26A, AN/GRC–26B, and AN/GRC–26C, Organizational Maintenance, Second Echelon.

*c.* **Forward comments concerning this publication directly to the Commanding Officer, United States Army Signal Publications Agency, Fort Monmouth, N. J.**

*Note.* For applicable forms and records, see paragraph 2, TM 11–5820–202–10.

## 2. Internal Differences in Models

Internal differences of Radio Sets AN/GRC–26A, AN/GRC–26B, and AN/GRC–26C are listed in the chart below. For external differences and other internal differences, see TM 11–5820–202–10. For differences in models of individual components of Radio Set AN/GRC–26(*), refer to their respective technical manuals (TM 11–5820–202–10, par. 1*c*).

*a. Teletypewriter Control Unit (All Models).*

| Item | Radio Teletypewriter Control C–808/GRC–26A | Transmitter-Teletypewriter Control C–808/GRC–26A |
|---|---|---|
| Filter circuit (Mark current power supply). | Capacitor C8, each section, is 25UF_____ | Capacitor C8, each section, is 30UF. |

*b. Radio Teletypewriter Control C–808/GRC–26A or Transmitter-Teletypewriter Control C–808A/GRC–26A.*

| Item | Some units | Remaining units |
|---|---|---|
| Mark current power supply___ | Resistor R9 is 1,000 ohms_____<br>Resistor R12 is 500 ohms_____ | Resistor R9 is 1,600 ohms.<br>Resistor R12 is omitted. |

*c. Radio Transmitter BC–610–I.*

| Item | Order No. 3357–Phila–52 and 25679–Phila–53 | Other units |
|---|---|---|
| Meter M2 circuit_____ | Resistor R39, 1 megohm, is connected between the negative (—) terminal of PA PLATE meter M2 and the meter case. | Resistor R39 is not provided in units on orders procured prior to Order No. 3357–Phila–52 and 25679–Phila–53. |

*d. Speech Amplifier BC–614–I.*

| Item | Order No. 3357–Phila–52 and 25679–Phila–53 | Other units |
|---|---|---|
| Sidetone oscillator circuit____ | Resistor R147 and R148, 100 ohms each, are connected in the control grid circuits (pins 4 and 1, respectively). | Resistors R147 and R148 are not provided in units procured on orders prior to Order No. 3357–Phila–52. |

*e. Frequency Shift Exciters O–39B/TRA–7 and O–39C/TRA–7.*

| Item | Order No. 3135–Phila–51 and 3357–Phila–52 | Other units |
|---|---|---|
| Ac input or dc power supply circuit. | Fuse F102, 3 ampere, is omitted_____<br><br>Fuse F103, .3 ampere, is added between terminal 8 of transformer T101 and ground. | Fuse F102, 3 ampere, is connected between switch S105 and connector J103.<br>Fuse F103, .3 ampere, is not provided. |

*f. Radio Receiver R–388/URR.*

| Item | Units used with the AN/GRC–26(*) | Other units |
|---|---|---|
| Disabling relay (K101) circuit_ | The contacts of relay K101 which are connected to capacitor C214A and B are strapped together. | The contacts of relay K101 which are connected to capacitor C214A and B are unstrapped. |

## 3. System Application (fig. 1)

*a.* Radio Set AN/GRC–26(*) is used at army, corps, and division levels to provide long range radioteletypewriter and voice signal communication. It is used in point-to-point (A, fig. 1), net (B, fig. 1), and remote system (C, fig. 1) operations. The point-to-point system can be operated on either duplex or one-way reversible (half-duplex) basis; the net system can be operated on a one-way reversible basis only.

*b.* Through the remote facilities, the radio set can provide radiotelephone and RTT signal communication for telephone and teletypewriter equipment, respectively, located up to 1 mile from the radio set shelter.

*c.* The radio set can be used in a system to communicate with any tactical or fixed station facility capable of using continuous-wave (cw), voice frequency, or frequency-shift keying (fsk) within a 2- to 18-megacycle (mc) band. The following list contains radio equipments which may be used for communication with Radio Set AN/GRC–26(*).

| Component | Frequency range (mc) |
|---|---|
| Radio Set AN/GRC–10_____ | 4 to 23 |
| Radio Receiving Set AN/FRR–12. | 1.25 to 40 |
| Radio Receiving Set AN/FRR–33. | .5 to 32 |
| Radio Receiving Set AN/FRR–38. | .5 to 32 |
| Radio Receiving Set AN/FRR–39. | .5 to 32 |
| Radio Receiving Set AN/FRR–40. | .5 to 32 |
| Radio Receiving Set AN/FRR–41. | .5 to 32 |
| Radio Transmitting Set AN/FRT–22. | 4 to 25.6 |
| Radio Sets AN/GRC–26, AN/GRC–26A, –26B, –26C, and –26D. | 2 to 18 |
| Radio Set AN/GRC–41_____ | .54 to 54 (rcvr)<br>2 to 18 (xmtr) |
| Radio Receiver Set AN/GRR–5_ | 1.5 to 18 |
| Radio Set AN/MRC–2_____ | 1.5 to 18 (rcvr)<br>2 to 18 (xmtr) |
| Radio Receiver AN/VRR–2____ | 1.6 to 2.9 |
| Radio Transmitter BC–191____ | 2 to 12.5 |
| Radio Receiver BC–312_____ | 1.5 to 18 |
| Radio Receiver BC–342_____ | 1.5 to 18 |

| Component | Frequency range (mc) |
|---|---|
| Radio Transmitter BC–447_____ | 2 to 13.4 |
| Radio Transmitter BC–610_____ | 2 to 18 |
| Radio Receiver Assembly OA–58/GRC. | .54 to 32 |
| Radio Receiver O–274/FRR____ | .54 to 54 |
| Radio Receiver R–388/URR____ | .5 to 30 |
| Radio Receiver R–390/URR____ | .5 to 32 |
| Radio Transmitter T–4/FRC___ | 2 to 18 |
| Radio Transmitter T–158_____ | 2 to 18 |
| Radio Transmitter T–368/URT | 1.5 to 20 |

## 4. Radio Receiver R–388/URR (Modified) (fig. 20)

*a. Purpose.* The two Radio Receivers R–388/-URR used in each Radio Set AN/GRC–26(*) have been modified (MWO SIG 11–264A–1) to open (break-in) the receiver disabling circuit when operating in a radioteletypewriter (RTT) net; this modification permits reception on that receiver while the transmitter is in operation. The break-in feature is accomplished by operating a switch (BREAK-IN) in the receiver disabling relay circuit.

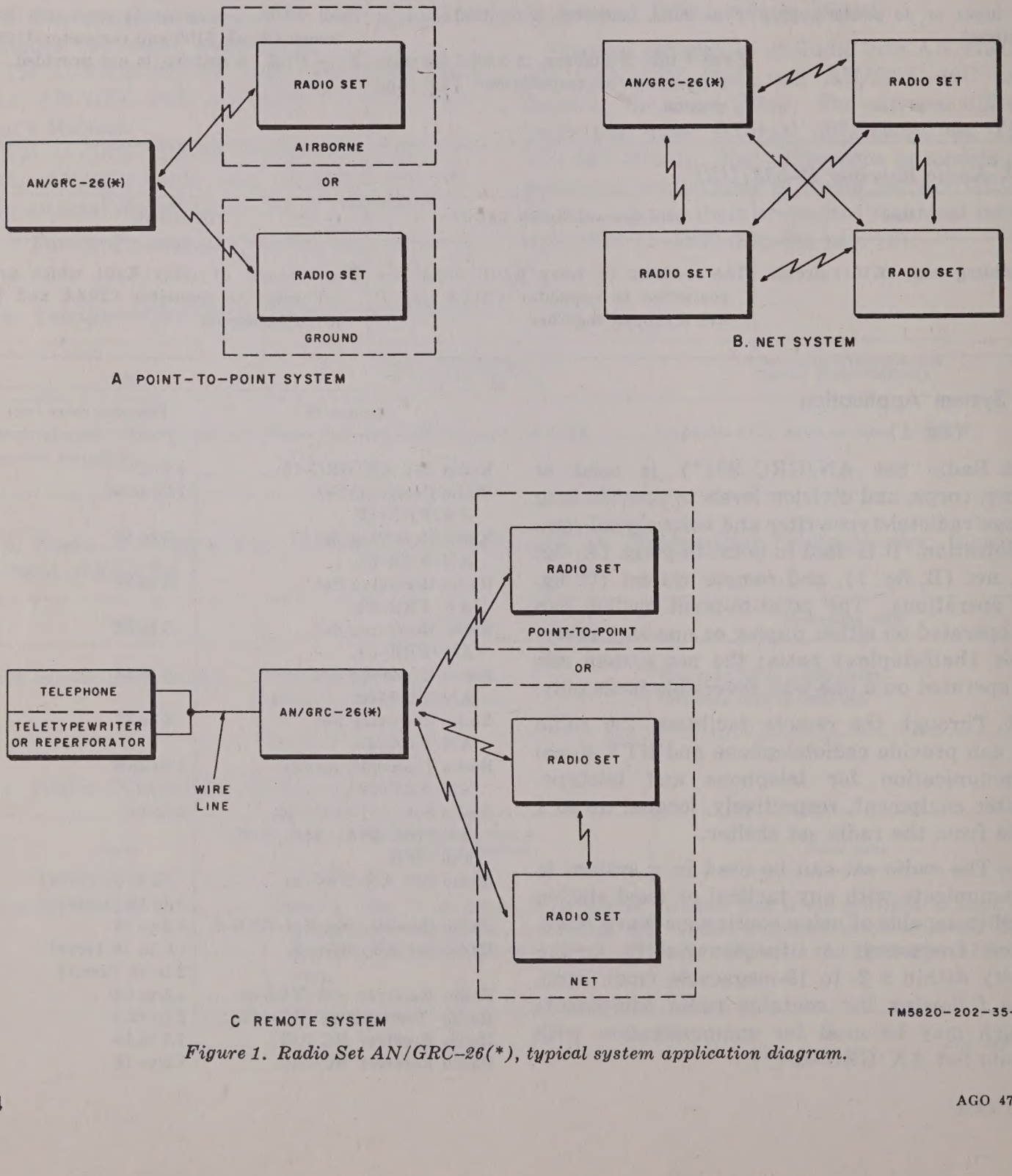



*Figure 1. Radio Set AN/GRC–26(*), typical system application diagram.*

*b. Operation.* Two Radio Receivers R–388/-URR (modified) are used when operating in the radioteletypewriter net.

(1) One receiver is tuned to the net operating frequency. When the BREAK-IN switch is operated to the ON position, the antenna and audio circuits of the receiver are disabled; however, there is enough leakage from the transmitter into the receiver to operate the frequency shift converter. The discriminator meter on the frequency shift converter may be used as a frequency indicating device.

(2) The other receiver is tuned to a calling frequency that is suitably removed (100 to 500 kilocycles (kc)) from the net operating frequency. The BREAK-IN switch is operated to the OFF position. The receiver is not disabled when the transmitter is turned on. When the calling frequency is sufficiently separated from the net operating frequency, so that the receiver may be used to intercept calls while the transmitter is in operation, break-in operation of the net is provided.

***Caution:*** **The receiver should not be tuned to the transmitter frequency with the BREAK-IN switch in the OFF position, because the antenna is ungrounded; and the antenna coil may become damaged by rf voltages from the transmitter.**

# CHAPTER 2
# THEORY

## Section I. THEORY OF RADIO SET AN/GRC–26(*)

### 5. Transmission Circuits, General

The transmission circuits of Radio Set AN/GRC–26(*) are covered on a block diagram basis in TM 11–5820–202–20. Detailed schematic and system analyses of the major components are covered in their respective technical manuals (TM 11–5820–202–10, par. 1*c*). Characteristics of the transmitting and receiving antennas are given in paragraph 6. Emergency manual keying is given in paragraph 7. Detailed circuit analyses of the transmission control circuits of the radio set are given in paragraphs 8 and 9.

### 6. Antennas

For dual diversity operation, the radio set uses one doublet antenna for transmitting and two doublet antennas for receiving. For mobile operation, the radio set uses one whip antenna for transmitting and one or two whip antennas for receiving. For detailed information on antennas and radiation patterns, refer to TM 11–486–6 and TM 11–666.

*a. Transmitting Doublet.* The doublet antenna is a bidirectional antenna which consists of two quarter-wave sections terminated at the center of RF Cable Assembly CG–557/U. The antenna is operated at either fundamental or odd harmonic frequencies.

*b. Receiving Doublets.* For dual diversity reception, the signal voltage is applied to each receiver from its associated doublet antenna. The two doublet antennas are spaced at least three wave lengths apart. These antennas are similar to the transmitting doublet antenna (*a* above) in construction and directivity. RF Cable Assembly CG–557A/U is used for the signal feed line between the antennas and the shelter. If possible, the paths of receiving antennas should not be directed across the local transmitting antenna.

### 7. Manual Keying Operation

Manual operation of the radio set is used when emergency conditions exist. Frequency-shift keying and continuous-wave keying are used to accomplish manual operation.

*a. Transmitting.* When frequency shift keying is used, the transmitted intelligence is in the form of Morse code. Relay O 1, in the teletypewriter control unit (fig. 13), is controlled by the frequency-shift keying device in the same manner as by the teletypewriter equipment. The relay is operated to the mark position when a dot or dash is sent and to the space position when a key-up condition exists. The hand key is used to accomplish frequency shift keying. The key is inserted into FS KEYING jack J16 on the teletypewriter control unit. (During normal remote operation of the radio set, teletypewriter signals from the remote site are applied to the FS KEYING jack.) By opening and closing the key, the relay operates as described in paragraph 11.

*b. Receiving.* When receiving manually frequency shift keyed signals, the outputs of the radio receivers or the frequency shift converter may be used. When using the receivers, the controls are set in the same positions as for monitoring teletypewriter signals. The receiver is tuned for the mark signal (assigned frequency) and the beat frequency oscillator (bfo) is set for the space frequency; a dash or dot is represented by an 850-cycle per second (cps) tone, and the spacing intervals between the dots, dashes, and characters are represented by no tone in the loudspeaker or headphones. When using the frequency shift converter, the

headphones are inserted into the PHONES KEYED TONE jack (TM 11–5062) to receive the frequency shift keyed Morse signals. Use of the frequency shift converter permits the simultaneous reception of voice and fsk signals.

*c. Cw Keying.* When cw keying is used, the carrier wave is transmitted when the key is closed and interrupted when the key is open. Two circuits have been provided for emergency keying. Figure 2 shows one such circuit which involves the speech amplifier and the radio transmitter. For the complete schematic diagram covering either of the two components, refer to their respective technical manuals (App.) The headphones are connected to the phones jack on the receiver.

(1) One circuit for cw keying is contained in the speech amplifier and the transmitter (fig. 2). The circuit shown in figure 2 is completed by inserting a closed hand key into KEY jack J101 on the speech amplifier. Keying is accomplished by closing the key and connecting the cathode circuit (consisting of coils CH2 and CH9, resistor R35, and capacitor C3) of RF oscillator V8 in the radio transmitter, to ground. Note that EXCITER PLATE POWER switch SW3, when closed, grounds the cathode circuit of the oscillator; therefore, for cw keyed transmission, SW3 must be in the NORMAL (open) position.

(2) The other circuit provided for cw keying is contained in the teletypewriter control unit and the frequency shift exciter (TM 11–257). Keying is accomplished by operating the hand key which is inserted into CW KEYING jack J9 on the teletypewriter control unit. The operation of the hand key causes relay K101 (fig. 3), in the frequency shift exciter, to energize and deenergize, which in turn operates the RF oscillator and the buffer stages also contained in the freqeuncy shift exciter. Additional information concerning cw keying from the teletypewriter control unit is given in paragraph 8.

## 8. Transmitter Enabling Circuit

*a. General.* The transmitter enabling circuit arranged for sending cw signals is shown in figure 3. The speech amplifier and the radio set control unit serve only as feedthrough devices. The terminal and connector designations are shown in the figure; refer to figure 21 for the actual cabling arrangements. The transmitter circuits may also be enabled and disabled from Radio Set Control Group AN/GRA–14 when operating the remote teletypewriter equipment. For a detailed discussion of the the remote control circuits, refer to paragraph 19.

*b. NORMAL—C-W BREAK-IN Switch.* This 4-pole, double-throw switch prevents the RF coils in Radio Receiver R–388/URR from burning out during cw transmission. It also prevents the continuous energizing and deenergizing of the high-voltage and antenna relays in the transmitter unit during cw transmission when the switches are in the positions shown in figure 3.

(1) The switch is operated to the C-W BREAK-IN position when the signals transmitted from the teletypewriter control unit are cw-keyed signals only (hand key is inserted in jack S9). In this position, contacts 1 and 2 of relay K101 are no longer used to complete the enabling circuit; therefore, relays RY1 and RY4 in the transmitter do not energize and deenergize as the hand key makes and breaks the circuit. One section of XMTR ON-XMTR OFF switch S6 is connected in the circuit to provide control of the transmitter from the teletypewriter control unit. When the XMTR ON-XMTR OFF switch is operated to the XMTR ON position, the enabling circuit is completed as shown in figure 3.

(2) The switch is operated to the NORMAL position when the signals transmitted from the teletypewriter control unit are either teletypewriter or telephone. In this position, relay K101 in the frequency shift exciter must be energized to complete the transmitter enabling circuit.

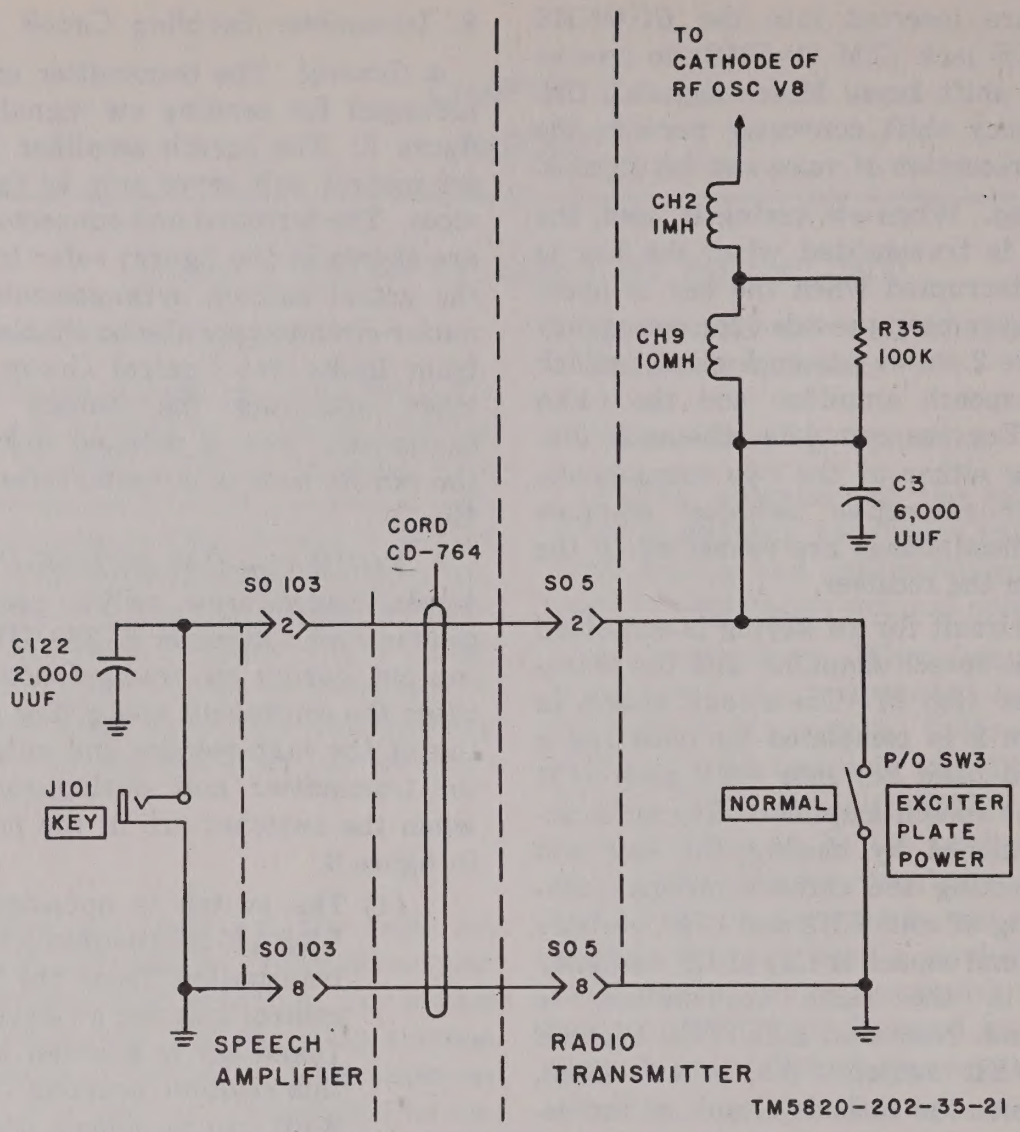



*Figure 2. Speech Amplifier BC–614–(*) and Radio Transmitter BC–610–(*), cw keying circuit.*

(3) In either position of the NORMAL—C-W BREAK-IN switch, plate power relay RY1 in the transmitter energizes to enable the transmitter. (Note that PLATE POWER switch SW6 is shunted and the overload protection relay (RY2) contact is closed.) When relay RY1 energizes, its contacts complete the primary circuits to transformers T5 and T6 and to antenna shorting relay RY4. Relay RY4 removes the short from radio frequency (rf) output terminals E4 and E5 to permit transmission from the radio transmitter.

*c. Frequency Shift Exciter Relay K101.* Contacts 1 and 2 of relay K101 are used to complete the transmitting enabling circuit when signals are transmitted from the teletypewriter control unit. The other contacts of the relay are used in the frequency shift exciter to complete the signal circuit paths rather than perform switching control. The relay receives its excitation power from the rectifier power supply in the frequency shift exciter.

(1) When switch S104 is operated to the NORMAL position and the cw key is not inserted in the C-W KEYING jack, the relay circuit is from terminal 6T of the relay coil through terminals C of connectors J106 and J13, the contacts of the C-W KEYING jack, terminals D of connectors J13, J106, J107, and J12, current-limiting resistor R1, switch S5, and terminals C of connectors J12 and J107 to ground.

The circuit is completed from ground through the direct current (dc) source to terminal 5B of the relay coil.

(2) When switch S104 is operated to the MARK position, current-limiting resistor R1 and switch S5 are shorted, completing the relay energizing path and enabling the transmitter as shown in figure 3. With the cw key inserted into the C-W KEYING jack, relay K101 energizes only when the key is closed. Contacts 1 and 2 of the relay affect the enabling of the transmitter only when the NORMAL—C-W BREAK-IN switch is in the NORMAL position.

*d.* If cw keying is attempted when the NORMAL—C-W BREAK-IN switch is in the NORMAL position, and PLATE POWER switch S6 is opened, relays RY1 and RY4 will energize and deenergize repeatedly for each character transmission. These relays are not designed for rapid make-break operation.

## 9. Receiver Disabling Circuits

*a. General.* The receivers are disabled when transmitting on a one-way reversible basis. For receiver disabling to occur, relay K401 (tone oscillator) and the switches must be in the positions as shown in figure 4. The disabling is accomplished by grounding the incoming signal in the RF input circuit of the receiver.

*b. Relay K401.*

(1) One side of the energizing path for relay K401 is completed from terminal 6T of the relay coil through terminals D of connectors J404 in the tone oscillator, and J10 in the teletypewriter control unit, switch S4 (in the ONE WAY position), contacts 10 and 2 of the NORMAL — C-W BREAK-IN switch (in the C-W BREAK-IN position), terminals A of connectors J13 in the teletypewriter control unit and J106 in the frequency shift exciter, contacts 2 and 1 of relay K101, terminals B of connectors J106 and J13, contacts 1 and 9 of the NORMAL—C-W BREAK-IN switch, and switch S5 (in the XMTR ON position) to ground. The other side of the relay winding is completed from terminal 6B through voltage-dropping resistor R409 in the tone oscillator and terminals D of connectors P405 and J106 to the +150-volt regulated power supply in the frequency shift converter. When the relay energizes, its upper contacts (1 and 2) and lower contacts (1 and 2) both close to apply 20 volts dc from rectifier CR401 to receiver disabling relays K101 in the channel A and B radio receivers. When energized, relay K101 grounds the receiving antenna input at jack J101.

(2) Lower contact 4 of relay K401 connects the plates of tubes V105 and V113 (not shown) to ground to insure that a steady marking condition is established on the teletypewriter loops when the radio receivers are disabled. Receptacle J401 can be used for emergency receiver disabling when relay K401 does not energize. By connecting a 12-volt dc source between terminals A and B on the receptacle, relays K101 in the radio receivers energize to provide disabling as described in (1) above.

*c. Frequency Shift Exciter Relay K101.* The energizing path for relay K101 is given in paragraph 8*c*. This relay controls the disabling of the radio receivers when the NORMAL—C-W BREAK-IN switch is in the C-W BREAK-IN position, and the signals transmitted from the teletypewriter control unit are cw-keyed signals. Each time the cw key at the teletypewriter control unit is closed, relay K101 energizes and its 1 and 2 contacts close to disable the receivers. The disabling is accomplished by grounding the incoming signal at the RF input circuit in the receivers. When the NORMAL—C-W BREAK-IN switch is in the NORMAL position, relay K101 does not affect the receiver disabling circuits. The receivers are disabled when the NORMAL—C-W BREAK-IN switch is in either position while transmitting if the ONE WAY-FULL DX switch is in the ONE WAY position.

*d. Remote Receiver Disabling Circuits.* Fig-

ure 4 also shows the remote control circuits for disabling the receivers. The control circuits in the radio set control unit take over the disabling circuits from the teletypewriter control unit when the switches in the energizing circuit of relay K101 (radio set control unit) are in the positions shown, and TELETYPE switch S103 is operated to the RADIO position. The control circuits in Radio Set Control Group AN/GRA–14 are given in paragraph 19.

## Section II. THEORY OF RADIO TELETYPEWRITER CONTROL C–808/GRC–26A (OR TRANSMITTER-TELETYPEWRITER CONTROL C–808A/GRC–26A)

### 10. General

*a.* Radio Teletypewriter Control C–808/-GRC–26A or Transmitter-Teletypewriter Control C–808A/GRC–26A is the key unit of Radio Set AN/GRC–26(*), because it directs the incoming and outgoing signals according to the settings of its controls. The teletypewriter control unit performs the following functions:

(1) Provides power for the operation of the local and remote sending teletypewriter equipments.

(2) Selects the particular teletypewriter equipment which is to be used.

(3) Supplies polar mark and space signals to the frequency shift exciter.

(4) Receives incoming mark and space signals from the frequency shift converter through Radio Set Control C–1306/GRA–14 and applies them to the teletypewriter equipment selected.

(5) Selects type of service (full-duplex or one-way reversible) to be used.

(6) Provides extension circuits for remote operation when associated remote control equipment is inoperative.

(7) Provides and controls circuits for cw and frequency shift keying.

(8) Controls perforator-transmitter operation for the punching of prepared tapes.

*b.* The function of switches S4, S5, and S6 of the teletypewriter control unit are described in paragraph 9. Paragraphs 11 through 15 cover the remaining circuits and switching arrangements of the teletypewriter control unit.

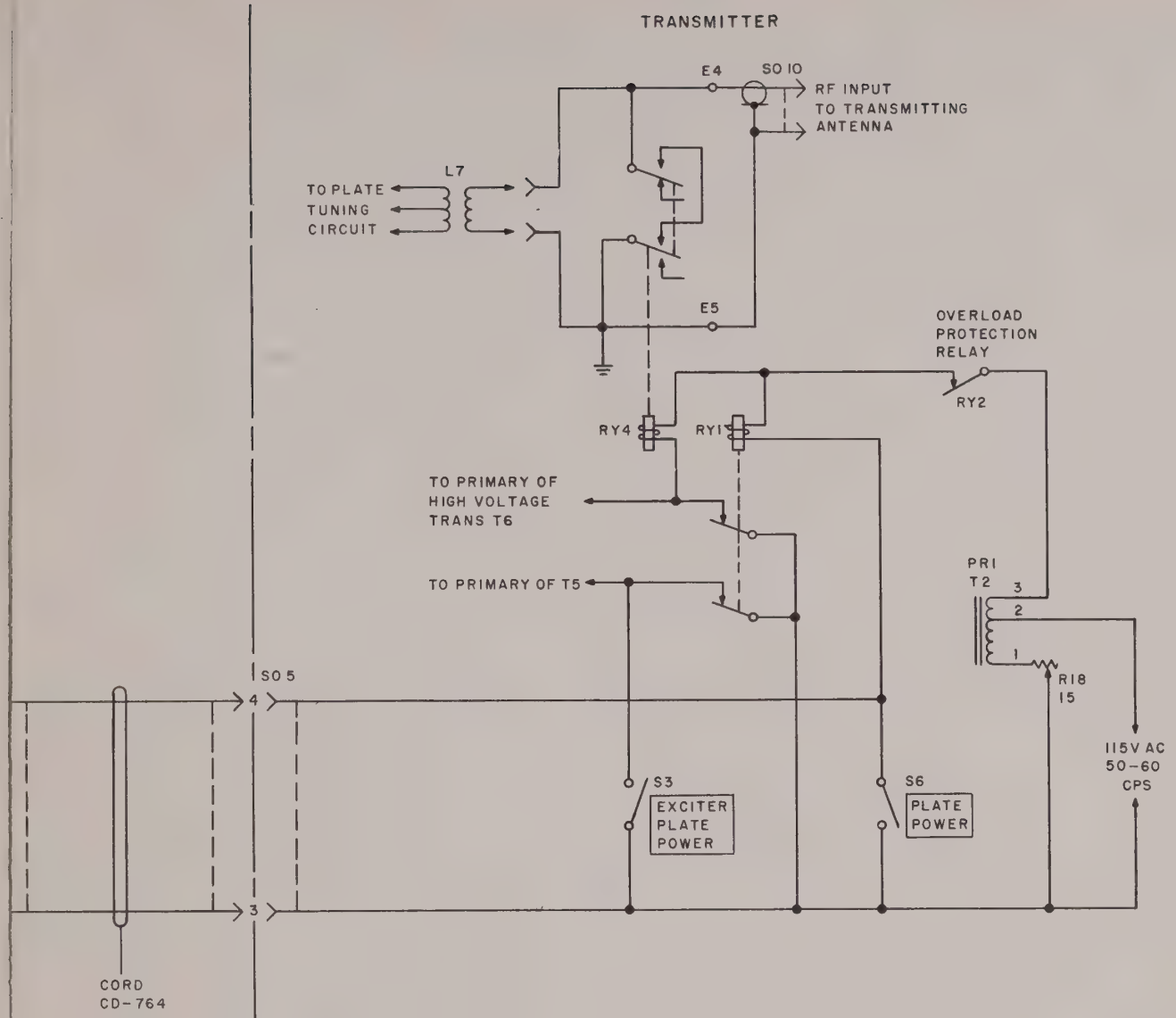
### 11. Teletypewriter Control Unit, Sending Circuit (fig. 13)

*a. General.* The switches are arranged as shown in the figure, except that switch S2 is set in the SEND TT position. In these positions, teletypewriter messages may be sent from the right teletypewriter, the transmitter-distributor, or the typing reperforator. These equipments are connected in series; therefore, simultaneous tape copy and page copy will be obtained from the typing reperforator and the teletypewriter, respectively. Remote sending operation is given in paragraph 18.

*b. TT TRANSPOSE Switch S1.* The sending circuits of the teletypewriter, transmitter-distributor, and typing reperforator connect to jacks J6, J5, and J8, respectively. The circuitry of the TT TRANSPOSE switch is so arranged that the sending contacts of the left teletypewriter (receiving) are removed from the series circuit when the switch is operated to the position indicated in *a* above. This circuit is wired to prevent interference with the incoming signals by operating the keyboard of the left teletypewriter. This arrangement is seen in figure 13 by observing that the sleeve side of send jack J3 terminates at contact 9 of the TT TRANSPOSE switch. When the TT TRANSPOSE switch is operated to the RIGHT REC LEFT SEND position, the sleeve side of send jack J6 is terminated at disconnected contact 7, thus removing the send contacts from the receiving circuit of the right teletypewriter. For either position of the TT TRANSPOSE switch, home copy of the transmitted message is received on the *sending* teletypewriter.

*c. Relay O 1.*

(1) Relay O 1 controls all frequency shift functions involving mark and space signals. The relay consists of two separate windings, 1–8 and 2–5. These windings control the movement of contact 6 to determine a mark or space condition. When contact 6 makes with contact 4, mark current from the




NOTE:
UNLESS OTHERWISE INDICATED,
RESISTANCES ARE IN OHMS.

ure 4 also shows the remote control circuits for disabling the receivers. The control circuits in the radio set control unit take over the disabling circuits from the teletypewriter control unit when the switches in the energizing circuit of relay K101 (radio set control unit) are in the positions shown, and TELETYPE switch S103 is operated to the RADIO position. The control circuits in Radio Set Control Group AN/GRA–14 are given in paragraph 19.

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(1) Provides power for the operation of the local and remote sending teletypewriter equipments.

(2) Selects the particular teletypewriter equipment which is to be used.

(3) Supplies polar mark and space signals to the frequency shift exciter.

(4) Receives incoming mark and space signals from the frequency shift converter through Radio Set Control C–1306/GRA–14 and applies them to the teletypewriter equipment selected.

(5) Selects type of service (full-duplex or one-way reversible) to be used.

(6) Provides extension circuits for remote operation when associated remote control equipment is inoperative.

(7) Provides and controls circuits for cw and frequency shift keying.

(8) Controls perforator-transmitter operation for the punching of prepared tapes.

*b.* The function of switches S4, S5, and S6 of the teletypewriter control unit are described in paragraph 9. Paragraphs 11 through 15 cover the remaining circuits and switching arrangements of the teletypewriter control unit.

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*a. General.* The switches are arranged as shown in the figure, except that switch S2 is set in the SEND TT position. In these positions, teletypewriter messages may be sent from the right teletypewriter, the transmitter-distributor, or the typing reperforator. These equipments are connected in series; therefore, simultaneous tape copy and page copy will be obtained from the typing reperforator and the teletypewriter, respectively. Remote sending operation is given in paragraph 18.

*b. TT TRANSPOSE Switch S1.* The sending circuits of the teletypewriter, transmitter-distributor, and typing reperforator connect to jacks J6, J5, and J8, respectively. The circuitry of the TT TRANSPOSE switch is so arranged that the sending contacts of the left teletypewriter (receiving) are removed from the series circuit when the switch is operated to the position indicated in *a* above. This circuit is wired to prevent interference with the incoming signals by operating the keyboard of the left teletypewriter. This arrangement is seen in figure 13 by observing that the sleeve side of send jack J3 terminates at contact 9 of the TT TRANSPOSE switch. When the TT TRANSPOSE switch is operated to the RIGHT REC LEFT SEND position, the sleeve side of send jack J6 is terminated at disconnected contact 7, thus removing the send contacts from the receiving circuit of the right teletypewriter. For either position of the TT TRANSPOSE switch, home copy of the transmitted message is received on the *sending* teletypewriter.

*c. Relay O 1.*

(1) Relay O 1 controls all frequency shift functions involving mark and space signals. The relay consists of two separate windings, 1–8 and 2–5. These windings control the movement of contact 6 to determine a mark or space condition. When contact 6 makes with contact 4, mark current from the

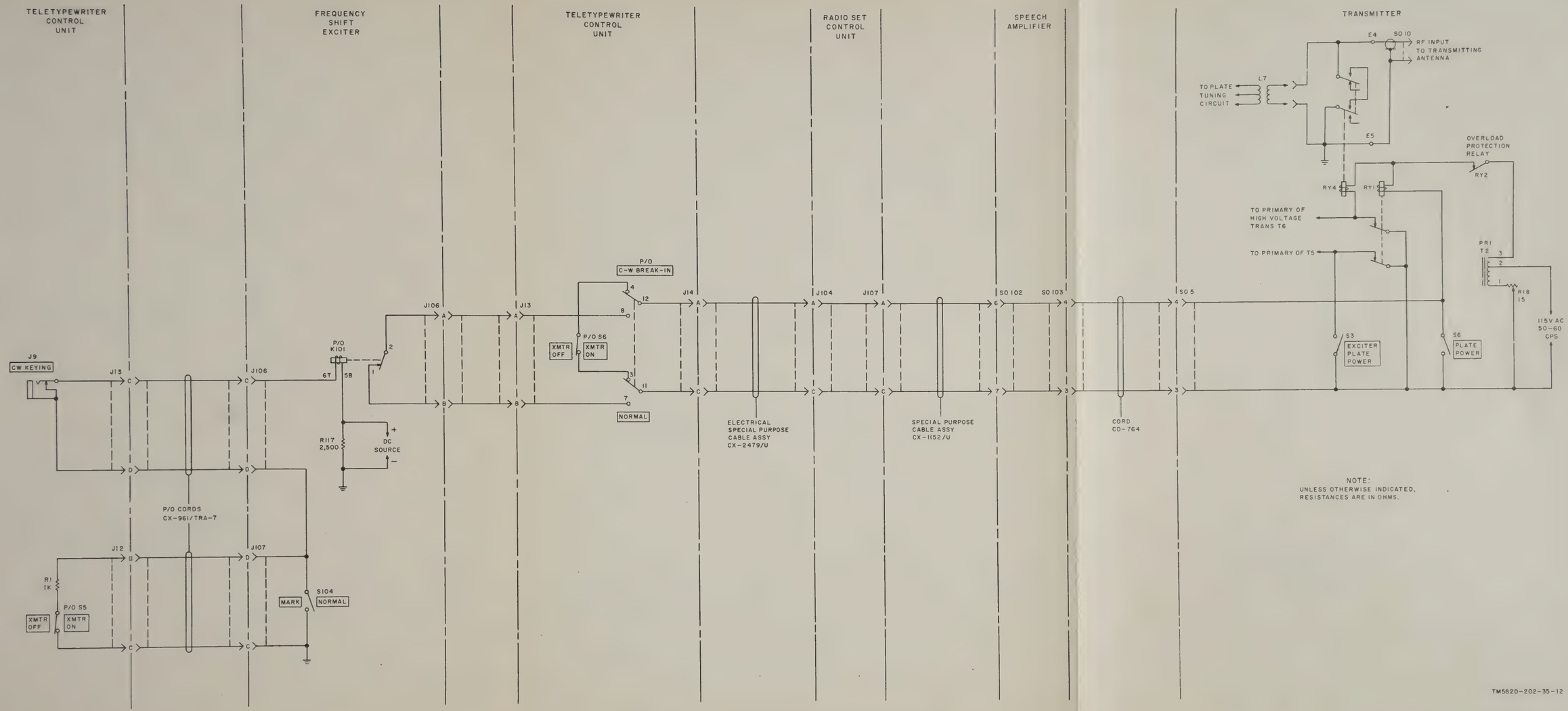



*Figure 3. Radio Set AN/GRC-26(*), transmitter enabling circuit.*

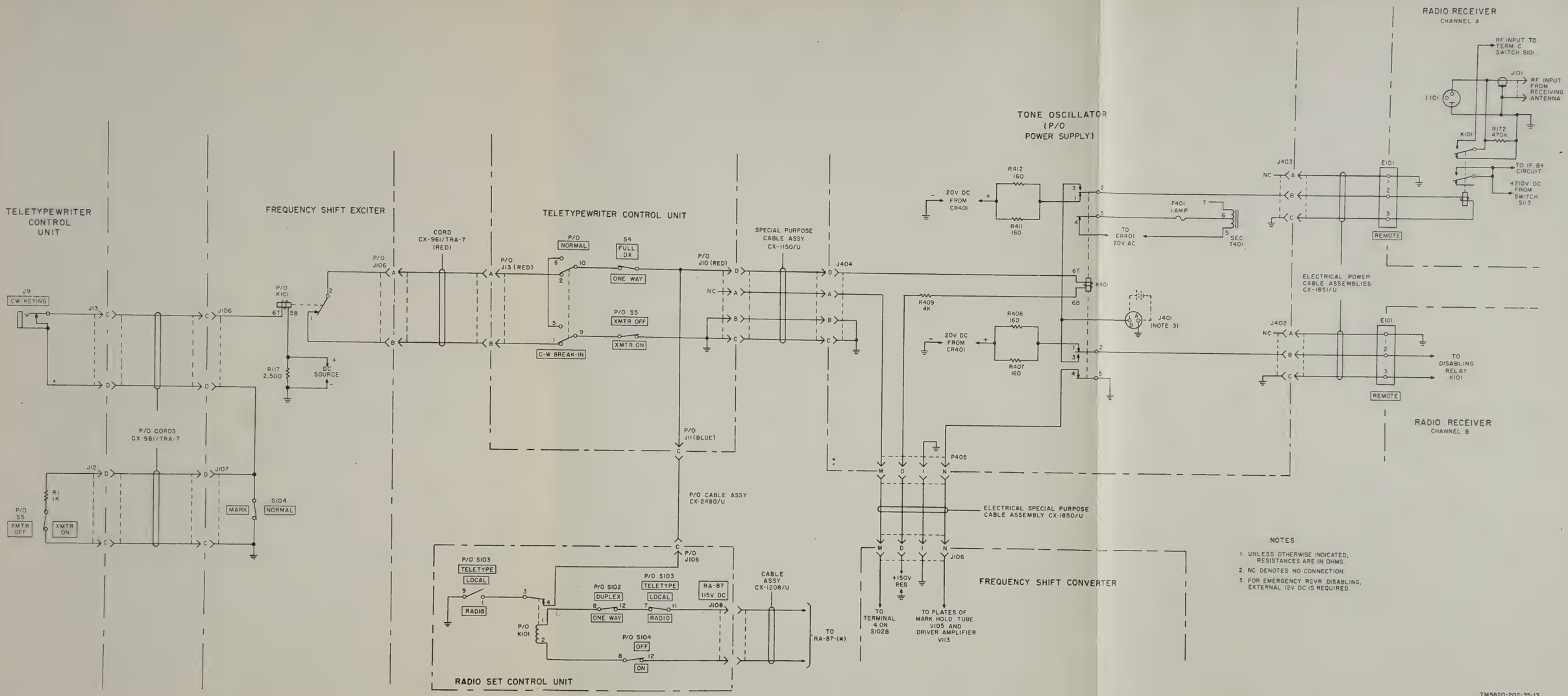



*Figure 4. Radio Set AN/GRC-26(*), receiver disabling circuits.*

mark current power supply (par. 14) flows in the output circuit of the teletypewriter control unit. When contact 6 makes with contact 7, space current from the space current power supply (par. 13) flows in the output circuit of the teletypewriter control unit.

(2) Winding 1–8 of relay O 1 receives a continuous holding current of approximately 30 ma from the space current power supply through current-limiting resistor R8. This action causes contact 6 to make with contact 7. When contact 6 is in this position, only space current is applied to terminal B of connector J12. This current is supplied from the negative terminal of the space current power supply through the metering circuit (*d* below), contacts 4 and 5 of switch S3, and the connector to the frequency shift exciter (TM 11–257).

(3) With switch S3 in the MARK position (*a* above), the mark current power supply delivers 60 ma through contacts 2 and 1 of switch S1 and jacks J4 and J5 of the right teletypewriter to contact 7 of switch S1. From contact 8 of switch S1, the path is completed through jack J5 of the transmitter-distributor, winding 2–3 of the relay, contacts 7 and 10 of switch S2 and jack J16 to ground. The current through winding 2–3 of the relay is greater than that through winding 1–8; this causes contact 6 to make with contact 4. This action permits current from the mark current power supply to flow through contacts 6 and 4, which is greater than and opposite to, the space current furnished to the output circuit by the space current power supply. The resultant mark current (approximately 20 ma) flows from the frequency shift exciter (not shown) through terminal B of connector J12, the contacts 5 and 4 of switch S3, the metering circuit, inductor L2, contacts 4 and 6 of the relay to the mark current power supply.

(4) Bypass capacitors C6 and C7 and C5 and C4 provide hash filtering for relay windings 2–3 and 1–8, respectively. Inductor L2 and capacitor C2 and C3 provide hash filtering for contacts 4 and 6 of the relay.

*d. Metering Circuit.* The measurement of the mark and space currents is accomplished by the circuit which consists of resistors R5 through R7 and 100–0–100 microampere (ua) meter M1. The meter indicates the current which flows to and from terminal B of connector J12. The current return path to the teletypewriter control unit is to terminal A of connector J12. Resistor R7 provides a low resistance shunt path for the metering circuit. Resistor R6 is a voltage-dropping resistor and resistor R5 is the meter calibration resistor. The actual circuit current (in milliamperes) may be determined by multiplying the meter reading (in microamperes) by 1000/3.

## 12. Teletypewriter Control Unit, Receiving Circuit

(fig. 13)

*a.* For the following discussion, the switches of the teletypewriter are operated as shown in the figure. When the switches are operated to the indicated positions, teletypewriter messages may be received on the left teletypewriter unit connected to jack J1. Messages may also be received on the typing reperforator connected to jack J7. Messages can still be sent from the right teletypewriter unit connected to jack J6; and home copy is received on the same unit.

*b.* The teletypewriter control unit receives two signals from the frequency shift converter: one is a neutral signal for the normal operation of the local teletypewriter equipment and the other is a polar signal. (See note below.) The neutral signals are applied from the frequency shift converter through the radio set control unit to terminal D of connector J11 on the teletypewriter control unit.

*Note.* When the NORMAL-EXTENSION switch is operated to the EXTENSION position, the polar signals at terminal B of connector J11 are applied to terminals E1 and E2. These terminals and their associated circuits were initially provided for connecting teletypewriter equipment from a remote location. Since Radio Set Control Group AN/GRA–14 has been added, input polar signals to terminals E1 and E2 are not used, and

the NORMAL-EXTENSION switch always remains in the NORMAL position.

*c.* From terminal D of connector J11, the neutral signal is applied through contacts 4 and 1 of switch S2 to jack J7 of the typing reperforator and through contacts 10 and 7 of switch S2 and contacts 5 and 4 of switch S1 to jack J1 of the left teletypewriter. The signal actuates the left (receiving) teletypewriter magnet and returns to ground through contacts 10 and 11 of switch S1. Simultaneously, tape copy of the received message is made on the typing reperforator. The signal supplied by the converter is of sufficient magnitude to operate all magnets in the teletypewriter circuit simultaneously. When no signal is applied, the mark-hold feature of the frequency shift converter supplies a constant mark signal to the receiver circuit. Jack J3 is disconnected from the circuit and jack J8 is short-circuited, so that it is impossible to send from these jacks when switch S1 is in the LEFT REC RIGHT SEND position. Any interruption of the series signal path will prevent the operation of the receiving teletypewriter and the typing reperforator.

*d.* To operate the right teletypewriter as the receiving set, switch S1 is operated to the RIGHT REC LEFT SEND position. The signal follows the same path given in *c* above until it reaches switch S1. With S1 in the new position, switch contacts 5 and 6 are shorted to send the signal through jack J4 to the teletypewriter control unit ground through switch contacts 11 and 12. Thus, the incoming receiving signal may be copied on either teletypewriter as selected by switch S1.

*e.* In addition to receiving on one of the teletypewriters (left or right) and sending on the other teletypewriter (right or left), additional transmitting facility may be obtained by operating the PERFORATOR OPERATION switch to the SEND TT position, and by using the perforator-transmitter as a sending device (provided that tape copy of the incoming message is not required) or by sending from a prepared tape by using the transmitter-distributor.

## 13. Space Current Power Supply

*a.* The space current power supply (fig. 13) is a conventional full-wave rectifier used to supply dc to the space-sending circuit (par. 11). The primary of T1 is connected to the 115-volt, 50- to 60-cps alternating current (ac) source through connector J15, ON–OFF switch S7, and 1 AMP fuse F1 (when S7 is in the ON position). The secondary consists of two windings. One winding supplies 6.3 volts at 2 amperes to AC SUPPLY indicator lamp I 2 and to TRANSMITTER indicator lamp I 1 (when S6 is in the XMTR ON position); the other supplies 29, 26.5, or 24 volts at 200 ma for the full-wave bridge rectifier SR1. The 24-volt tap is used when the equipment is new, but as the rectifier ages, it may be necessary to supply a higher ac voltage to the rectifier to obtain a sufficient dc output. The higher voltage can be obtained from the 26.5- or 29-volt tap.

*b.* The pulsating dc output of selenium rectifier CR1 is filtered by choke L1 and dual capacitor C1A and C1B. Potentiometer R3 and R4 are bleeder resistors used for space current adjustment. Resistor R2 limits the peak current applied to capacitor C1A. Capacitor C3 provides an ac path to ground for hash and ripple voltages.

## 14. Mark Current Power Supply

*a.* The mark current power supply is a full-wave rectifier used to supply dc to the mark sending circuit (par. 11). The primary of transformer T2 is connected to the 115-volt, 50- to 60-cps source through receptacle J15, switch S7, and 1 AMP fuse F1 (when S7 is in the ON position). The secondary consists of two windings. One winding supplies 5.1 volts at 4 amperes to the filaments of the two parallel rectifier tubes V1 and V2; the other supplies 264 volts center-tapped at 150 ma to the plates of the two rectifier tubes.

*b.* The two rectifier tubes V1 and V2 are duodiodes operated as full-wave rectifiers. The elements of the two tubes are connected in parallel to provide additional current handling capacity. The pulsating dc output from V1 and V2 is applied to the filter circuit which consists of choke L3 and dual filter capacitor C8A and C8B.

*c.* Potentiometer R10 serves both as a bleeder resistor for the power supply and as a coarse adjustment for the mark current. Fine adjust-

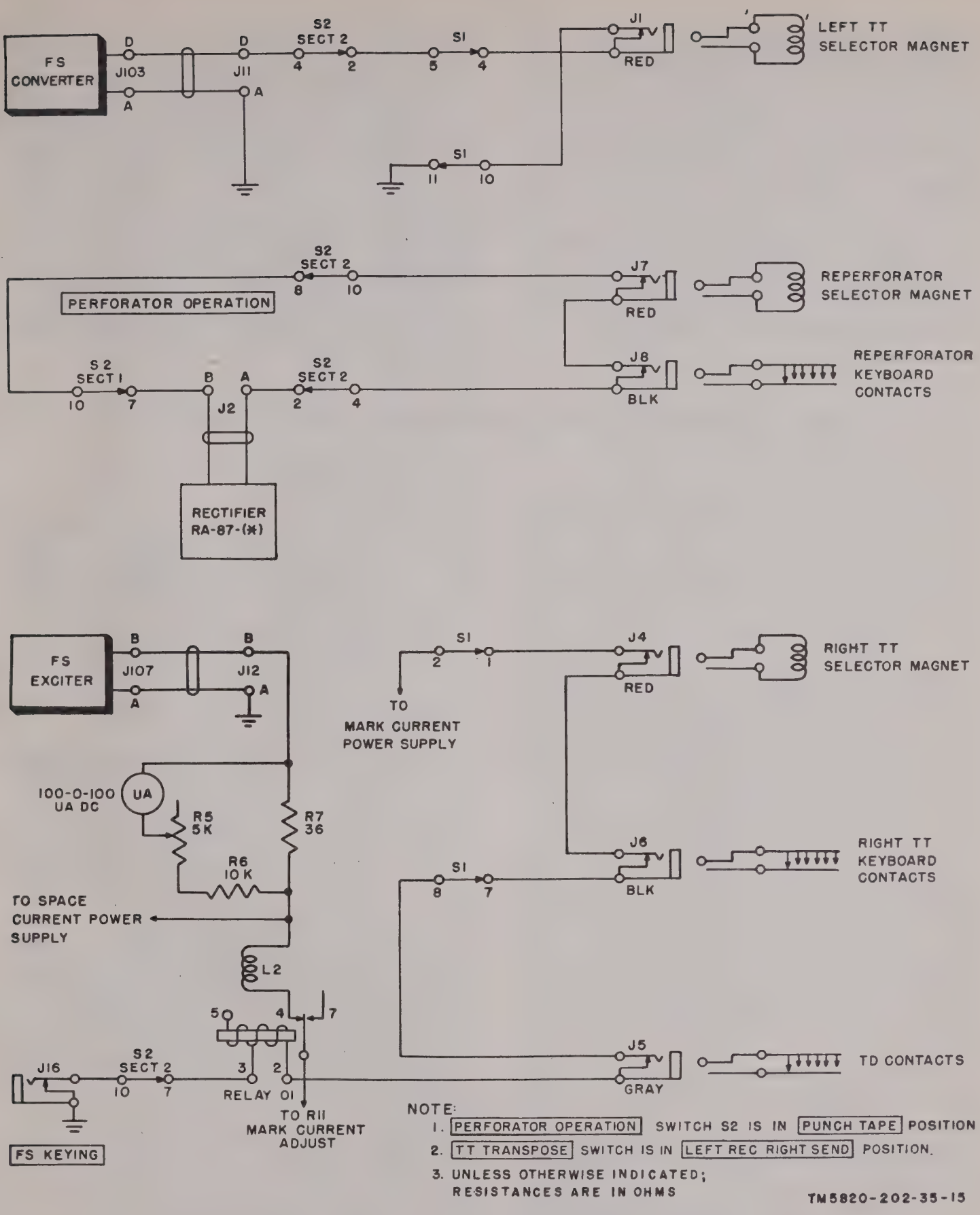



*Figure 5. Radio Teletypewriter Control C–808/GRC–26A, punch tape circuit.*

ment is accomplished by variable resistor R11. In some models of the control unit, resistor R9 is 1,600 ohms and variable resistor R12 is omitted. In other models of the control unit, R12 in conjunction with R9 adjusts the current through the teletypewriter equipments to the normal value of 60 ma. The primary windings of transformers T1 and T2 are connected in parallel. MARK-SPACE switch S8 connects the negative side of the power supply to ground and must be in the MARK position for normal operation.

### 15. Punch Tape Circuit

The perforator-transmitter sending and receiving circuits are described in paragraphs 11 and 12. When the typing reperforator is to be used only to perforate tape, PERFORATOR OPERATION switch S2 is set to the PUNCH TAPE position. The normal sending and receiving functions of the teletypewriter equipment are unchanged, because the typing reperforator now is isolated from the sending and receiving circuits (fig. 5). Jacks J7 and J8 are in series with a 60-ma dc obtained from Rectifier RA–87–(*).

## Section III. THEORY OF RADIO SET CONTROL GROUP AN/GRA–14

### 16. General

*a.* Radio Set Control Group AN/GRA–14 consists of Radio Set Control C–1306/GRA–14 and Remote Switching Control C–1307/GRA–14. Figures 15 and 17 are schematic diagrams of the respective units. The radio set control unit provides switching and control circuits for connecting the remote communication equipment and selecting the type of operation to be used. The remote switching control unit serves as a connecting and switching unit for the remote communication equipment at the remote site. The control group has no effect on the normal operation and control of the radio set at the local site; however, the same type of transmission *cannot* be performed simultaneously from each location. For example, telephone transmission from the local site and teletypewriter transmission from the remote site may be performed simultaneously to a distant station, but neither site may send teletypewriter signals or telephone signals at the same time.

*b.* The control group provides remote control operation of Radio Set AN/GRA–26(*) at a distance up to 1 mile. In one-way reversible operation, the receiver is disabled while the transmitter is being used. A single frequency or two different frequencies may be used for transmitting and receiving. In full-duplex operation, separate frequencies are used for transmitting and receiving; the receiver and transmitter are operated simultaneously.

### 17. Telephone Circuits

*a. General.*

(1) Each of the two control units provides connections for telephone communication between radio set shelter and the remote site over telephone lines. A hybrid transformer is used with the telephone system for voice modulation of the transmitter and to minimize the modulation of the transmitter by the output of the receiver.

(2) A ringing circuit for signaling the operator at either location is provided as part of the telephone used. The ringing control circuit is so designed that ringing pulses do not energize the transmitter or cause a break in the signal being received.

*b. Local Operation.* Local telephone operation is provided between the local site (shelter) and the remote site. Telephone communication is possible when TELEPHONE switch S101 (fig. 15) is operated to the LOCAL position, and telephones are connected to binding posts E107 and E108, and E7 and E8 (fig. 17) on the radio set and remote switching control units, respectively. In figure 17, the remote telephone terminals are shown connected to binding post E2, and through capacitor C1, to binding post E1. Capacitor C1 blocks the 115-volt dc source from the voice circuits. From the remote switching control unit, the telephone lines are connected to binding posts E101 and E102 on

the radio set control unit (fig. 15). The voice circuits are completed to binding post E107 and E108 through terminal 7 of switch E101 on one side and through capacitor C103 and terminal 8 of switch S101 on the other. Capacitor C103 also blocks the 115-volt dc source from the voice circuits.

*c. One-Way Reversible Radiotelephone Operation.* Radiotelephone operation is possible when TELEPHONE switch S101 is operated to the RADIO position. The position of ON-OFF switch S104 does not affect operation.

(1) *Transmitting.* The voice signal from the remote site is transmitted over field wires to CONTROL AND TEL LINE binding posts E101 and E102 (fig. 15). From E101, one side the voice circuit is completed through contacts 11 and 3 of switch S101, terminals 7 and 8T of hybrid HY101, blocking capacitor C101, and contacts 10 and 2 of switch S101 to jack J102. From binding post E102, the other side of the voice circuit is completed through blocking capacitor C103, contacts 12 and 4 of switch S101, and terminals 4 and 3T of the transformer to the sleeve side (ground) of J102. If the local telephone is used, the voice circuit is completed on one side from binding post E107, through terminals 8 and 8T of the hybrid transformer to jack J102. From binding post E108, the other side of the voice circuit is completed through HYBRID BALANCE control R104, blocking capacitor C102 and the hybrid transformer (terminals 3 and 3T) to the sleeve side (ground) of jack J102. Either the local or remote telephone may be used for transmission. The voice signals from either telephone may be monitored by the unused telephone. The voice signals are applied to Speech Amplifier BC–614–(*) by connecting Special Purpose Cable Assembly CX–2482/U from the BC–614 J102 jack to the CARBON MIC. 1 jack of the speech amplifier.

(2) *Receiving.* The incoming signal from Radio Receiver R–388/URR is applied through Electrical Special Purpose Cable Assembly CX–2481/U (fig. 21) to R-388 PHONES jack J101 on the radio set control unit (fig. 15). The signal is applied to terminals 1 and 2 of the hybrid transformer. From the tip of jack J101, one side of the voice circuit is completed through contacts 9 and 7 of hybrid HY101. The other side of the circuit is completed from the sleeve of jack J101 through resistor R102 to terminal 2 of the hybrid transformer. Resistors R101 through R103 comprise an attenuating network which reduces the level of the voice signal to a value that will not overload the telephone circuits, while the gain controls of the receiver may be advanced sufficiently to permit signal monitoring on the loudspeaker in the shelter. The signal appearing across terminals 1 and 2 of the hybrid transformer is induced into the secondary and applied to the local and remote telephones as described in (1) above.

*d. Full-Duplex Radiotelephone Operation.* In full-duplex radiotelephone operation, the voice signals use the same paths as those outlined in *c* above for one-way reversible operation. The transmitter is energized continuously and the receiver is not disabled. When the HYBRID BALANCE control is properly adjusted, minimum signal from the receiver is applied to the output of the speech amplifier. The receiver signal is induced equally in both center-tapped coils. Because the output to the speech amplifier is taken from the center tap of each coil, a balanced condition exists, and no voltage (induced from the audio output of the receiver) appears between these two points. The HYBRID BALANCE control makes up for the difference in resistance between the long remote telephone lines and the short local telephone connections. It is adjusted for minimum modulation of the transmitter (par. 36*d*), as indicated on the meter of the speech amplifier, while a signal is being received.

## 18. Teletypewriter Circuits

*a. General.* Two sets of jacks are provided

on the remote switching control unit for the teletypewriter circuits. One set of jacks (fig. 17), designated ONE WAY OR RECEIVE DUPLEX, is used for connecting a single teletypewriter for sending and receiving on a one-way reversible basis, as well as for receiving during duplex operation. The other set of jacks, designated SEND DUPLEX, is used to connect a teletypewriter for sending on a full-duplex basis. The teletypewriter circuits of the remote switching control unit are connected to the radio set control unit at the local site by field wire.

*b. Radioteletype Receiving Circuits.* When operating the teletypewriter equipment on a one-way or full-duplex basis, the receive circuit is connected to one or two of the set of jacks which consist of J1, J2, or J3. The paths for the received teletypewriter signals are the same for one-way reversible and full-duplex operation. Binding posts E3 and E4 on the remote control unit are connected through the field wires to TELETYPE LINE 1 binding posts E103 and E104 on the local control unit (fig. 15). Binding post E103 is connected through contacts 17 and 18 of relay K101 to terminal D of CV–182 J103 jack. Binding post E104 is connected through contacts 14 and 13 of relay K101 to terminal D of C–808 J11 jack J106. As a result, the remote teletypewriters are made a part of the receiving neutral loop that exists between the local machines, the frequency shift converter, and the teletypewriter control. TELETYPE LINE 2 binding posts E105 and E106 are short-circuited through terminal 5 of ONE WAY-DUPLEX switch S102 when the switch is operated to the ONE WAY position. The same part of switch S102 short-circuits the C–808 FS KEY jack through contacts 9 and 10 of relay K101. *The relay is not energized for radioteletype reception in either one-way or duplex operation.*

*c. Radioteletype Transmitting Circuits.*

(1) *One-way reversible operation.* When sending signals on a one-way reversible basis, ONE WAY-DUPLEX switch S102 (radio set control unit) is operated to the ONE WAY position. When contacts 8 and 12 of S102 make, relay K101 energizes (relay K101 shown in the deenergized position in figure 15), and the contacts close to complete the path of the signals from the remote switching control unit to the radio set control unit at the local site. These signals are applied to TELETYPE LINE 1 binding posts E103 and E104. One side of the line is completed from binding post E103 through contacts 17 and 16 of relay K101, and contacts 5 and 9 of switch S102, to the sleeve side of the C–808 FS KEY jack. The other side of the line is completed from binding post E104 through contacts 14 and 15 or relay K101 to the tip side of the C–808 FS KEY jack. Electrical Special Purpose Cable Assembly CX–1324/U is used to complete the signal path from the C–808 FS KEY jack (fig. 15) to the FS KEYING jack on the teletypewriter control unit (fig. 13).

(2) *Full-duplex operation.* When sending signals on a full-duplex basis, ONE WAY-DUPLEX switch S102 is operated to the DUPLEX position. As a result, contacts 8 and 12 break to deenergize relay K101 (fig. 15). When the relay deenergizes, its contacts release to apply the start-stop teletypewriter signals from the teletypewriter equipment (connected to the SEND DUPLEX jacks (fig. 17) at the remote switching control unit) at the remote site to the teletypewriter control unit at the local site. The send line is completed by field wire connection from binding posts E5 and E6 of the remote switching unit to binding posts E106 and E105 (fig. 15), respectively, of the radio set control unit. In the radio set control unit, one side of the signal path is completed from E106 through contacts 9 and 10 of relay K101 to the tip contact of the C–808 FS KEY jack. The other side of the signal path is completed from binding post E105 to the sleeve contact of the C–808 FS KEY jack. The signals are applied to the teletype-

writer control unit as described in (1) above.

*d. Local Operation.* The teletypewriter equipment at the local and remote sites may be operated for local communication when the radio set is selected for full-duplex radiotelephone operation. When local communication is desired, TELETYPE switch S103 (fig. 15) is operated to the LOCAL position and ONE WAY-DUPLEX switch S102 is operated to the DUPLEX position in which relay K101 is deenergized. When two teletypewriters are available at the remote site, full-duplex operation is possible; however, when only one teletypewriter is available, the equipment should be operated on a one-way reversible basis. The receiving teletypewriter at the remote site receives its signals over the same circuit as for radioteletype reception described in *b* above. Signals from the sending teletypewriter at the remote site are applied to the teletypewriter control unit through the same circuits as described in *c*(2) above.

## 19. Control Circuits

*a. One-Way Reversible Operation.* For transmission on a one-way reversible basis (radioteletype or radiotelephone) from the remote site, switch S1 (fig. 17) on the remote switching control unit is operated to the ON position to energize the transmitter or disable the receiver; switch S103 (fig. 15) is operated to the RADIO position, switch S104 to the ON position, and switch S102 is operated to the ONE WAY position. With each of the switches in the above positions, a dc path exists between CONTROL AND TEL LINE binding posts E1 and E2 (fig. 17) through inductor L1 on the remote switching control unit for energizing relay K101 (fig. 15). (Inductor L7 provides a low resistance path for the dc control circuit and, at the same time prevents a short circuit for voice signals across the telephone connected to terminals E7 and E8.)

(1) One side of the energizing path of relay K101 is from terminal 2 of the relay coil through contacts 8 and 12 of switch S102, binding post E101, field wire to binding post E1 of the remote switching control unit (fig. 17), inductor L1 ON-OFF switch S1 to binding post E2. From the remote switching control unit, the path is completed through field wire, binding post E102 (fig. 15), contacts 11 and 7 of switch S102, and 3 and 11 of switch S103 to the positive side of the dc source. The other side of the energizing path is completed from terminal 1 of the relay coil through contacts 8 and 12 of switch S104 to the negative side of the dc source.

(2) When TELETYPE switch S103 is operated to the LOCAL position, the energizing path for relay K101 is completed from the positive side of the dc source through contacts 11 and 7 of switch S103, and contacts 12 and 8 of switch S102, to terminal 2 of the relay coil. The path from terminal 1 of the relay coil is the same as for the RADIO position of the TELETYPE switch ((1) above). Switch S1 on the remote switching control unit has no control over the equipment at the local site when the TELETYPE switch is operated to the LOCAL position.

(3) With the TELETYPE switch in the RADIO position, terminal C of C–808 J11 connector J106 is grounded through closed contacts 4 and 3 of relay K101 and 1 and 9 of switch S103. Through the connecting cable from the radio set control unit to the teletypewriter control unit, terminal D of connector J10 (fig. 13) of the teletypewriter control unit is grounded. The grounding of this terminal causes the receiver to be disabled (par. 9).

(4) When the relay is energized and the TELETYPE switch is in the RADIO position, terminal B of C–808 J14 connector J104 (fig. 15) is connected through contacts 10 and 2 of switch S103 and contacts 6 and 5 of the relay to ground. Through the connecting cable from the radio set control unit, terminal D of connector J12 (fig. 13) on the teletypewriter control unit is connected through resistor R1 to ground. This connection enables the transmitter (par. 8).

*b. Full-Duplex Operation.* For full-duplex operation, the switches of the radio set control unit are in the same positions as explained in *a* above, except that ONE WAY-DUPLEX switch S102 is in the DUPLEX position. When switch S102 is operated to the DUPLEX position, relay K101 in the radio set control unit deenergizes and terminal B of connector J104 is grounded through contacts 10 and 2 of switch S103, contacts 11 and 7 of switch S104, and 2 and 10 of switch S102. This permits the transmitter and receiver to operate (par. 8 and 9) simultaneously.

*c. Local Teletypewriter Operation.* To permit local teletypewriter operation without enabling the transmitter, the circuit between terminal B of connector J104 and ground is opened at the TELETYPE switch when it is in the LOCAL position (*a*(2) above). To permit the operators to monitor incoming signals while using the teletypewriters, the receiver is not disabled. Whether or not the relay is energized, terminal C of connector J106 is not grounded, because it is opened at terminal 1 of the TELETYPE switch when the switch is in the LOCAL position (*a*(1) above). To enable the transmitter when the TELETYPE switch is in the LOCAL position, the TEST switch on the frequency shift exciter is operated to the MARK position. This will complete the transmitter control circuit.

## 20. Indicator Circuits (fig. 15)

*a. TRANS Lamp I 102* (fig. 15). This lamp lights when the transmitter is on except when TELETYPE switch S103 is in the LOCAL position.

(1) *One-way reversible operation.* When the remote teletypewriter equipment is operating on a one-way reversible basis, the cathode side of lamp I 102 is connected to the negative side of the dc source through contacts 4 and 12 of switch S103 and contacts 8 and 12 of ON-OFF switch S104. The circuit is completed from the plate side of the lamp through current-limiting resistor XI 102, which is part of the lamp socket, binding post E101, the remote control circuit which consists of field wire, switch S1 (fig. 17) and inductor L1 in the remote control unit, back to binding post E102, to contacts 11 and 7 of ONE WAY-DUPLEX switch S102 and contacts 3 and 11 of TELETYPE switch S103, to the positive side of the dc source.

(2) *Full-duplex operation.* When the equipment is operating on a full duplex basis, the negative side of the source is connected to the lamp through the same path as described in (1) above. The positive side of the dc source is connected through contact 4 and 12 of ONE WAY-DUPLEX switch S102 to the lamp.

*b. LOCAL TELETYPE Lamp I 101* (fig. 15). This lamp lights when TELETYPE switch S103 is in the LOCAL position. The plate side of the lamp is connected through the current-limiting resistor, designated XI 101 to the positive side of the dc source. The cathode side of the lamp is connected through contacts 8 and 12 of switches S103 and S104 to the negative side of the dc source.

*c. RECEIVE Lamp I 103* (fig. 15). This lamp is lighted when ON-OFF switch S104 is in the ON position and relay K101 is not energized. The plate side of the lamp is connected through its current-limiting resistor, designated XI 103, and contacts 7 and 8 of the relay to the positive side of the dc source. The cathode side of the lamp is connected through contacts 8 and 12 of ON-OFF switch S104 to the negative side of the dc source.

*d. TRANS Lamp I 1, Remote Switching Control Unit* (fig. 17). This lamp lights whenever ON-OFF switch S1 on the remote switching control unit is in the ON position. It is connected through its current-limiting resistor XI 1, the line cord, and one side of switch S1 to the ac source at the remote site.

## Section IV. POWER DISTRIBUTION

### 21. General

The connections from the main power source to the individual units are shown in figure 6. This power source may be either a Power Unit PE–95–(*) or any other source (military or commercial) which is capable of delivering at least 6 kilowatts (kw) at 115 volts, 50–60 cps. The main power line terminates in the power circuit breaker which will break the circuit automatically, when more than 60 amperes pass through it. Ac power is distributed to principal power lines from the circuit breaker to specific components (par. 22). Several secondary lines also exist (par. 23).

### 22. Principal Lines

Line No. 1 delivers power through the 15-ampere lighting circuit breaker to the fluorescent lighting system. Line No. 2 delivers power to the blower, frequency shift exciter, and teletypewriter control unit. Line No. 3 delivers power to the two teletypewriters, radio receivers, and the frequency shift converter. When Electrical Equipment Cabinet CY–1216/-U is used, line 4 delivers power to two teletypewriters, the frequency shift converter, and five 115-volt ac convenience outlets in the wiring channel of the electrical equipment cabinet. Line No. 4 also delivers power to the heater and to Rectifier RA–87–(*). Line No. 5 delivers power only to the transmitter. Several receptacles are provided for supplying 115 volts ac to accessory equipment. If trouble such as an open occurs in one of the lines, the equipment in that line may be switched to another line until the trouble can be cleared.

### 23. Secondary Lines

*a.* Power Supply PP–712–(*)/GRC–26A receives its power from the frequency shift converter (par. 22). For detailed information covering the power supply, refer to TM 11–5062.

*b.* The typing reperforator of Perforator-Transmitter TT–56/MGC receives its operating power from Rectifier RA–87–(*) when PERFORATOR OPERATION switch S2 (in the teletypewriter control unit) is in the PUNCH TAPE position. The rectifier supplies 60 ma dc to the typing reperforator line circuit in the teletypewriter control unit. Refer to TM 11–2201 for power and connection diagrams.

*c.* Speech Amplifier BC–614–(*) receives its power from Radio Transmitter BC–610–(*). Refer to TM 11–826 or TM 11–5054 for additional power information covering the speech amplifier.

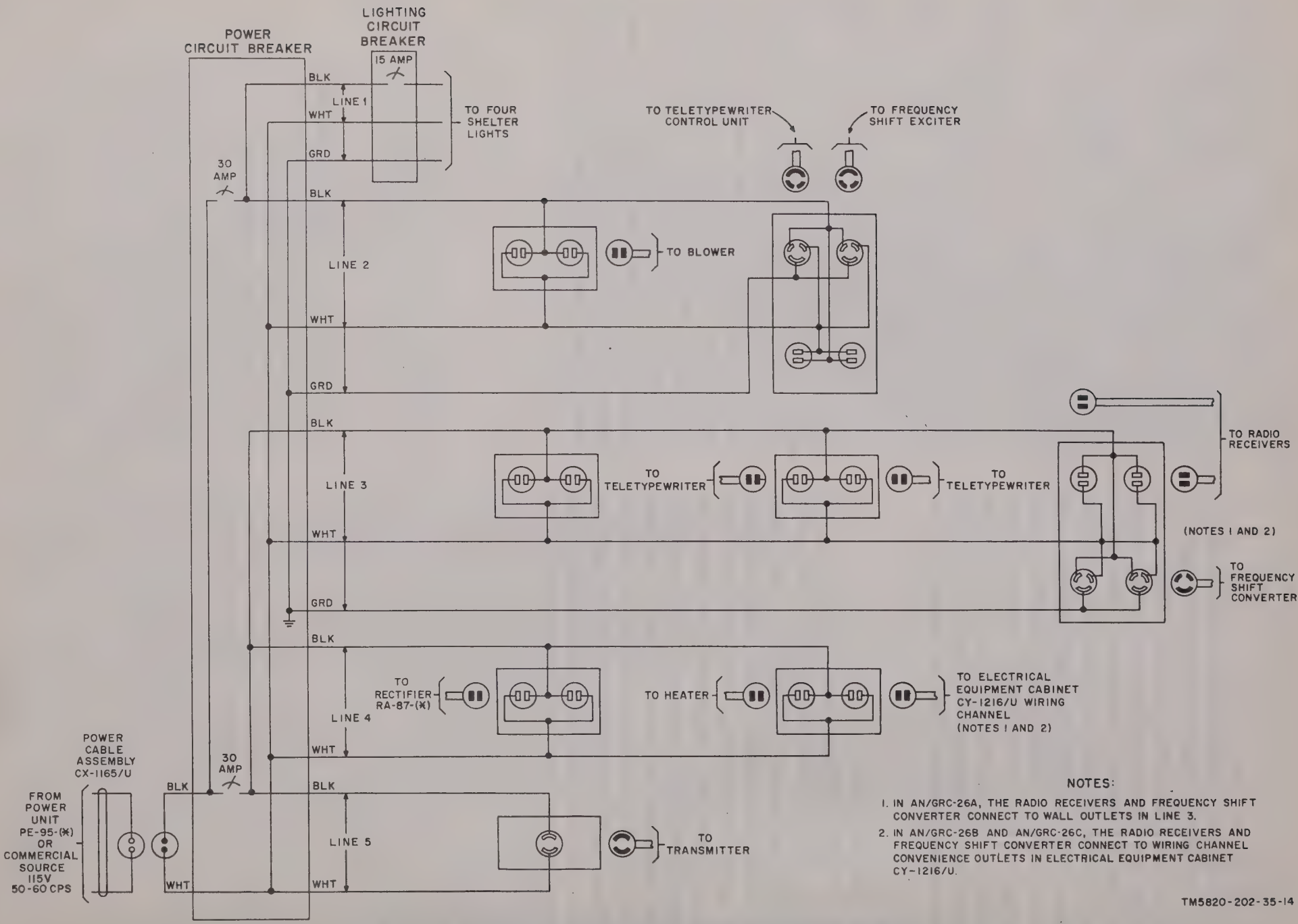

POWER CIRCUIT BREAKER
LIGHTING CIRCUIT BREAKER
15 AMP
BLK
LINE 1
WHT
GRD
TO FOUR SHELTER LIGHTS
30 AMP
TO TELETYPEWRITER CONTROL UNIT
TO FREQUENCY SHIFT EXCITER
LINE 2
TO BLOWER
LINE 3
TO TELETYPEWRITER
TO TELETYPEWRITER
TO RADIO RECEIVERS
(NOTES 1 AND 2)
TO FREQUENCY SHIFT CONVERTER
LINE 4
TO RECTIFIER RA-87-(*)
TO HEATER
TO ELECTRICAL EQUIPMENT CABINET CY-1216/U WIRING CHANNEL (NOTES 1 AND 2)
POWER CABLE ASSEMBLY CX-1165/U
FROM POWER UNIT PE-95-(*) OR COMMERCIAL SOURCE 115V 50-60 CPS
LINE 5
TO TRANSMITTER
NOTES:
1. IN AN/GRC-26A, THE RADIO RECEIVERS AND FREQUENCY SHIFT CONVERTER CONNECT TO WALL OUTLETS IN LINE 3.
2. IN AN/GRC-26B AND AN/GRC-26C, THE RADIO RECEIVERS AND FREQUENCY SHIFT CONVERTER CONNECT TO WIRING CHANNEL CONVENIENCE OUTLETS IN ELECTRICAL EQUIPMENT CABINET CY-1216/U.
TM5820-202-35-14

*Figure 6. Radio Set AN/GRC–26(*), power distribution diagram*

# CHAPTER 3
# TROUBLESHOOTING

## Section I. TROUBLESHOOTING TECHNIQUES

***Warning:*** **When servicing the radio transmitter, be extremely careful because of the high voltage exposed. Always operate the PLATE POWER switch to the OFF position and open the doors on the transmitter cabinet before starting any testing. With the high voltage turned off, potentials as high as 1,000 volts are still present in the transmitter. Keep one hand in a pocket when measuring voltages with the probe. Before touching any part after the voltage is turned off, short the part to ground with shorting stick (TM 11–5820–202–20, fig. 1). Read cautions in individual equipment manuals before attempting repair.**

### 24. General Instructions

The field and depot maintenance procedures in this manual *supplement* the procedures described in the operator's and organizational maintenance manuals. The troubleshooting procedure, which begins with the operator's troubleshooting check list and equipment performance check list, is carried to a higher level in this manual. Localizing and isolating techniques used in the troubleshooting procedures are more advanced. This section provides troubleshoting procedures (par. 25), authorized test equipment (par. 26), general precautions (par. 27), teletypewriter control unit troubleshooting chart (par. 28), and signal substitution (par. 29). Paragraphs 30 through 32 provide troubleshooting data for Radio Set Control C–1306/GRA–14 and Remote Switching Control C–1307/GRA–14. For troubles in components other than those described in this manual, refer to the individual equipment manual (TM 11–5820–202–10, par. 1*c*).

### 25. Organization of Troubleshooting Procedures

*a. General.* The first step in servicing a defective radio set is to sectionalize the fault. Sectionalization means tracing the fault to the *major component* responsible for the abnormal operation of the radio set. The second step is to localize the fault. Localization means tracing the fault to the defective item responsible for the abnormal condition. This manual will be concerned only with *system* maintenance; that is, with tracing a trouble to a particular component. When the trouble has been isolated, the repairman then should refer to the technical manual covering the faulty unit.

*b. System Sectionalization.* Radio Set AN/GRC–26(*) should be set up for operation, following the starting procedure (TM 11–5820–202–10, par. 32). Check the operation of the components against the equipment performance check list (TM 11–5820–202–20, par. 7) until an abnormal indication is noted. Refer to the system troubleshooting chart (par. 28), which often will quickly indicate the defective item and the corrective measures to be taken. If the charts do not give sufficient information, the trouble must be localized within the defective component.

*c. Localization.* Localization is the tracing of an equipment fault to a particular item. Localization of trouble within a component of Radio Set AN/GRC–26(*) may be accomplished by following instructions in individual technical manuals which are furnished with the equipment.

### 26. Test Equipment Required

The following chart lists test equipment and their associated technical manuals (if any) required for troubleshooting Radio Set -AN/-GRC–26(*).

| Test equipment | Technical manual |
|---|---|
| Spectrum Analyzer TS–723A/U | TM 11–5097 |
| Audio Oscillator TS–382(*)/U | TM 11–2684 or TM 11–2684A |
| Test Set TS–2(*)/TG | TM 11–2208 |
| or | |
| Distortion Set TS–383(*)/GG | TM 11–2217 |
| Electronic Multimeter TS–505(*)/U. | TM 11–5511 or TM 11–5511A |
| Frequency Meter AN/URM–79 | TM 11–5094 |
| Frequency Meter AN/TSM–16 | |
| Frequency Meter AN/URM–32 | TM 11–5120 |
| Multimeter AN/URM–105 and Multirange Shunt Instrument MX–1471. | |
| Oscilloscope OS–8A/U | TM 11–1214 |
| Rf Signal Generator Set AN/URM–25. | TM 11–5551 |
| Telephone Test Set AN/PTM–6 | TM 11–2062 |
| Electron Tube Test Set TV–2(*)/U. | TM 11–2661 |
| or | |
| Electron Tube Test Set TV–7(*)/U. | TM 11–5083 |
| Tube Socket Adapter Kit MX–1258/U. | |
| Voltmeter Meter ME–30A/U | TM 11–5132 |

## 27. General Precautions

*a. High-Voltage Measurements.* High voltages are dangerous and can be fatal. Certain precautions must be followed when measuring voltages above a few hundred volts. When measuring high voltages, observe the following rules:

(1) Connect the ground lead to the voltmeter.

(2) Ground the case or panel of test instruments.

(3) Place one hand in your pocket.

(4) Ground all high-voltage circuits with the shorting stick (TM 11–5820–202–20, fig. 1).

(5) If the voltage to be measured is known to be less than 300 volts, make checks by touching the probe of the test lead to the hot terminal.

(6) If the voltage to be measured is known to be greater than 300 volts, shut off the power, connect the hot test lead, step away from the voltmeter, turn on the power, and note the readings on the voltmeter. *Do not touch any part of the voltmeter.*

*b. Resistance Measurements.*

(1) Before making any resistance measurements, disconnect the power source. An ohmmeter is essentially a low-range voltmeter and battery. If the ohmmeter is connected in a circuit that already contains voltages, the needle will be deflected off-scale and the voltmeter movement may be burned out.

(2) Capacitors always must be discharged before resistance measurements are made (pars. 31 and 32).

*c. Current Measurements.*

(1) Current measurements other than those indicated by the panel meters ordinarily are not required when troubleshooting the rf sections of the radio set. Under special circumstances, where the voltage and resistance measurements alone are not sufficient to localize the trouble, a current measurement can be made by opening the circuit and connecting an ammeter in series with the circuit to be measured. Series measurements of currents in teletypewriter lines often are made for trouble location purposes.

(2) When the meter is inserted in a circuit to measure current, it always should be inserted away from the rf end of the resistance. For example, when measuring plate current, do not connect the meter next to the plate of a tube, but insert it next to the end of the resistor which connects to the power source.

***Caution:*** **When measuring current, always set the meter at its highest range; then, if necessary, decrease the range of the meter to obtain an accurate reading.**

(3) In most cases, the current flows through a resistance which is either known or can be measured with an ohmmeter. The current flowing in the circuit can be determined by dividing

the voltage drop across the resistor by its resistance value. This method is better than that described in (1) above, because it does not subject the relatively delicate ammeter to damaging currents.

## 28. Troubleshooting Charts

*a. Teletypewriter Control Unit* (fig. 13).

| Indication and condition | Probable trouble | Correction |
|---|---|---|
| White AC SUPPLY lamp fails to light when POWER switch is in the ON position. | Switch S7, connector J15, or transformer T1 (primary winding or winding between terminals 7 and 8) defective. | Check items and replace defective items. |
| Green TRANSMITTER lamp fails to light when XMTR ON–XMTR OFF switch is in XMTR ON position. | Switch S6, defective | Check switch and repair or replace defective switch. |
| Meter indicates to left of center when MARK-SPACE switch is in MARK position (with Cord CX–961/TRA–7 (blue) connected to frequency shift exciter). *Note.* Check resistor R108 in frequency shift exciter for continuity first. | Transformer T2, choke L3, capacitors C8A, C8B; resistors R11, R10, or R9; switch S8; relay O 1 and inductor L2. | Check circuit elements and replace defective items. |
| Meter indicates improper reading when MARK-SPACE switch is in SPACE position. | Rectifier CR1 defective. Choke L1, capacitors C1A and B or C3 open; C4 or C5 shorted. Variable resistors R3 and R4 defective; connector J12 defective. | Check circuit elements. Repair, adjust, or replace defective items. |
| Meter indicates zero reading when MARK–SPACE switch is in SPACE position. | Transformer T1 (terminals 3 and 4) open; rectifier CR1 burned out; choke L1 open; capacitor C3 shorted; internal wiring defective. | Check R108 in the frequency shift exciter for continuity. Check T1 and CR1. Check remaining elements listed in the probable column. Replace all defective items. |
| Meter indicates no change in normal reading in either position of the MARK–SPACE switch. | Switch S8 shorted | Replace switch. |
| Receivers are not disabled when XMTR ON–XMTR OFF switch is in the XMTR ON position, FULL DX ONE WAY switch is in ONE WAY position, and NORMAL—C-W BREAK-IN switch is in the C-W BREAK-IN position (receivers, tone oscillator, teletypewriter and radio set control units connected). | NORMAL—C-W BREAK-IN switch, switches S4, and S5, or connector J10 defective. Relay K101 (frequency shift exciter) contacts 1 and 2 inoperative. Cord CX–TRA–7 defective. | Check switches, relay K101, and connector. Repair or place defective items. Refer to TM 11–257. |
| | Defective Power Supply PP–127(*)/GRC–26A or Radio Receiver R–388/URR. | Refer to TM 11–5062 or TM 11–854, respectively. |
| Receivers not disabled when XMTR ON–XMTR OFF switch is in XMTR ON position, FULL DX–ONE WAY switch is in ONE WAY position, and NORMAL C-W BREAK-IN switch is in the NORMAL position. | Same as 7 above, except for defective relay K101 (frequency shift exciter) and connecting cord. | Check for defective items listed in probable trouble column; repair or replace. |
| Transmitter is not disabled when NORMAL — C-W BREAK – IN switch is in the NORMAL position, and XMTR ON–XMTR OFF | Switch S6 shorted, NORMAL—C-W BREAK-IN switch shorted, or connectors J104 and J105 (radio set control unit) defective. | Check switches, connectors and wiring. Repair or replace defective items. |

| Indication and condition | Probable trouble | Correction |
|---|---|---|
| switch is in XMTR OFF position (teletypewriter and radio set controls units, frequency shift exciter, speech amplifier, and radio transmitter connected). | Defective frequency shift exciter, speech amplifier, or radio transmitter. | Refer to TM 11–257, TM 11–5054, or TM 11–826, respectively. |
| Transmitter is not disabled when XMTR ON–XMTR OFF switch is in XMTR OFF position and NORMAL C-W BREAK-IN switch is in the C-W BREAK-IN position. | Same as 9 above except switch S6. Switches S104, S5, and jack J9 defective; connectors J12 and J13 defective; relay K101 (frequency shift exciter), contacts 1 and 2, defective. | Check switches, connectors, jack and relay; repair or replace. For adjustment and repair of relay K101, refer to TM 11–257. |
| Typing reperforator does not prepare tape when PERFORATOR OPERATION switch is in PUNCH TAPE position. | Rectifier RA–87–(*) inoperative; Cord CX–1120/U defective; switch S2 defective; typing reperforator defective. | Check rectifier (TM 11–957 or TM 11–957A). Check cord, switch and typing reperforator (TM 11–2201). Repair or replace defective items. |

*b. Radio Set Control Group AN/GRA–14* (figs. 15 and 17).

| Indication and condition | Probable trouble | Correction |
|---|---|---|
| TRANS lamp I 102 does not light when switch S104 is in ON position, S103 is in RADIO position, and S102 is in DUPLEX position. | Defective switches S102, S103, or S104. Defective lamp. Defective Rectifier RA–87–(*). Cord CX–1208/U defective. | Check lamp; rectifier (TM 11–957 or TM 11–957A). Check switches. Replace or repair defective items. |
| TRANS lamp I 102 does not light when S102 is in the ONE WAY position, S103 in RADIO position, and S104 is in the ON position. | Inductor L1 and switch S1 (remote switching control unit (fig. 17)) defective. Field wire connection between radio set and remote switching control, units open. Switches S103 and S102 in the radio set control unit (fig. 15) defective. | Check field wire connections. Check inductor L1 and switch S1 (par. 32) in the remote switching control unit. Check switches S102 and S103 in the radio set control unit. Check the internal wiring at binding posts E1 and E2 (fig. 18) and E101 and E102 (fig. 16) on the remote switching and radio set control units respectively. |
| LOCAL TELETYPE lamp I 101 does not light when switch S104 is in the ON position and S103 is in the LOCAL position. | Defective switches S104 and S103. Defective lamp or lamp holder. Rectifier RA–87–(*) inoperative. Cord CX–1208/U defective. | Check lamp and lamp holder. Check rectifier, switches, and cord. Repair or replace defective items. |
| RECEIVE lamp I 103 does not light when switch S102 is in the ONE WAY position, S103 is in the RADIO position, and S104 is in the ON position (relay K101 de-energized). | Defective relay K101 (radio set control unit) contacts 7 and 8. Defective switch S104; defective lamp or lamp holder. Rectifier RA–87–(*) inoperative. Cord CX–1208/U defective. | Check lamp and lamp holder. Check continuity through contacts 7 and 8 of the relay. Check rectifier and cord. Repair or replace defective items. |
| TRANS lamp I 1 (remote switching control unit) does not light when switch S1 is in the ON position. | Power cord, lamp, lamp holder, or switch defective. | Check power cord; check lamp, switch, lamp holder. Check power source. Repair or replace defective items. |
| Receiver output is transmitted to speech amplifier during full-duplex radiotelephone operation. | HYBRID BALANCE control R104 misadjusted or defective. Transformer HY101 defective. | Adjust R104 for balance condition (par. 36*d*). Check R104. Check HY101 (par. 31*b*). Replace defective item. |
| Radiotelephone transmission not possible from remote site when S1 (fig. 17) is in either position. | Capacitor C1 open. Switch S101 (fig. 15) contacts 11 and 3 defective. Telephone defective. | Check C1, switch S101, and contacts 11 and 3. Check field wire connections. Check telephone (TM 11–333). |

| Indication and condition | Probable trouble | Correction |
|---|---|---|
| Radiotelephone transmission is not possible from either the local or remote site. | Transformer HY101 winding 7 and 8, defective. Capacitor C101 open. Switch S101 contacts 2 and 10 defective. Jack J102 and cable CX–2482/U defective. | Check HY101 (par. 31*b*). Check C101, jack J102, S101, and the cable. Repair or replace any defective items. |
| No radiotelephone reception at either site. | Cord CX–2481/U defective. Switch S101, contacts 9 and 1, and resistors R101 through R103 defective. Transformer HY101 winding 1–2 or 3–4 defective. | Check cord connection and continuity. Check switch contacts resistors and HY101. Replace any defective items. |
| No local telephone reception at remote site. | Field wire connections faulty. Capacitor C103 (fig. 15) open. Switch S101 and contacts 8 and 12, defective. Internal wiring in the control units defective. | Check field wire, switch S101, C103, and wiring. Repair or replace defective items. |
| Teletypewriter messages cannot be transmitted or received from the remote teletypewriter on a one-way reversible basis. | Defective relay K101 (fig. 15). Jacks J1 through J3 (fig. 17) defective. Faulty field wire connections on Cord CX–2480/U. | Check relay, jacks, cord, and field wire. Repair or replace any defective items. |
| Teletypewriter messages cannot be transmitted or received from the remote site on a full-duplex basis. Teletypewriter equipment operates properly. | Jacks J4 through J6 defective. Switch S102 (fig. 15) and contacts 9 and 5 defective. Jack J105, switch S104, and relay K101 defective. | Check jacks for operation and continuity. Check switches, relay, and jack for proper operation. Repair or replace defective items. |

## 29. Signal Substitution

*a.* The defective component or defective stage in the radio set often can be located by substituting a signal of the type that is normal to the input of the component or stage. Signal substitution requires a source of audio, IF, RF, and dc teletypewriter signals. In addition, a headset (Headset HS–30–(*)) or a loudspeaker (Loudspeaker LS–3) and both a good transmitting teletypewriter signal source and a good receiving teletypewriter are required. Refer to the technical manual for the component being tested (TM 11–5820–202–10, par. 1*c*), the test equipment, and procedures for signal substitution and signal tracing.

*b.* A tube tester and multimeter are needed to isolate the defective part after the faulty stage has been located by signal substitution.

*c.* Adjust the receiver volume, and listen for serious distortion from the loudspeaker or headset at the various points in the signal substitution procedure. When working back from the output to the input stages, decrease the output of the signal generator as much as possible. If possible, compare with the other Radio Receiver R–388/URR when it is known that the other receiver is in good condition.

*d.* Check the wiring and soldering in each stage during the procedure.

*e.* Do not remove the shield of a tuned unit until the trouble has been traced definitely to that particular unit. Do not damage the wiring by pushing it back and forth during inspection. Be careful not to damage the component that is being worked on.

*f.* Misalinement in one or more stages will cause reduced output. Misalinement of an oscillator may prevent output.

*g.* When trouble is localized in a given stage, first test the tube, if such a test is indicated; then measure the voltage (current of teletypewriter series circuits) and, finally, measure the resistance at the tube socket of that stage.

*h.* Trouble in a circuit may not cause changes in voltage or resistance measurements at the tube socket. The instructions included in this paragraph are merely a guide and should suggest other procedures, such as voltage and resistance measurements on individual parts.

## Section II. TROUBLESHOOTING DATA

### 30. General

Take advantage of the material supplied in this manual. It will help in the rapid location of trouble. Consult the troubleshooting data in the equipment technical manuals (TM 11–5820–202–10, par. 1*c*), the parts locations diagrams (par. 33*b*), and the following material.

| Fig. No. | Par. No. | Description |
|---|---|---|
| | 51 (TM 11–5820–202–20) | Operator's troubleshooting check list. |
| | 7 (TM 11–5820–202–20) | Equipment performance check list. |
| 6 (TM 11–5820–202–20) | | Radio Teletypewriter Control C–808/GRC–26A, tube location diagram. |
| 7 (TM 11–5820–202–20) | | Radio Teletypewriter Control C–808/GRC–26A, voltage and resistance diagram. |
| 13 | | Radio Teletypewriter Control C–808/GRC–26A, schematic diagram. |
| 14 | | Radio Teletypewriter Control C–808/GRC–26A, wiring diagram. |
| | 26 | Teletypewriter control unit, troubleshooting chart. |
| 15 | | Radio Set Control C–1306/GRA–14, schematic diagram. |
| 16 | | Radio Set Control C–1306/GRA–14, wiring diagram. |
| 17 | | Remote Switching Control C–1307/GRA–14, schematic diagram. |
| 18 | | Remote Switching Control C–1307/GRA–14, wiring diagram. |
| 6 | | Power distribution diagram. |
| 19 | | Electrical Equipment Cabinet CY–1216/U, schematic diagram. |
| 20 | | Radio Receiver R–388/URR (modified), schematic diagram. |
| 21 | | Radio Set AN/GRC–26(*), interconnection schematic-wiring diagram. |
| 22 | | Resistor color code marking. |
| 23 | | Capacitor color code marking. |

### 31. Radio Set Control C–1306/GRA–14, Voltage and Resistance Measurements

Make the measurements given in *a* and *b* below with all cables connected (except Power Cable Assembly CX–1208/U) but with the field wires removed and all units of Radio Set AN/GRC–26(*) turned off except the power and lighting circuit breakers. Failure to obtain an indication within 10 percent of the value listed means there is trouble in one or more of the parts indicated in the "Part to be checked" column. Use Multimeter AN/URM–105 or an equivalent meter. Check the suspected part with the meter; measure for continuity or open-circuit conditions and refer to figure 15.

*a. Voltage Measurements, Radio Set Control C–1306/GRA–14.*

Make voltage measurements with Rectifier RA–87–(*) turned on and connected to the radio set control unit.

| Test points | Test conditions | Correct voltage | Part to be checked |
|---|---|---|---|
| CONTROL AND TEL LINE binding posts. | ON-OFF switch at ON; TELEPHONE switch at RADIO; ONE WAY-DUPLEX switch at ONE WAY; TELETYPE switch at RADIO. | 110 dc | Coil of relay K101.<br>Switch S102.<br>Switch S103.<br>Switch S104. |
| TELETYPE LINE 1 binding posts. | Switches at any position | 0 | Internal wiring; check for shorts. |
| TELETYPE LINE 2 binding posts. | Switches at any position | 0 | Internal wiring; check for shorts. |

*b. Resistance Measurements, Radio Set Control C–1306/GRA–14.*

Turn off Rectifier RA–87–(*) and disconnect it from radio set control unit before making any resistance measurements.

| Test points | Test conditions | Correct voltage | Part to be checked |
|---|---|---|---|
| TELETYPE LINE 1 binding posts. | ON-OFF switch at OFF | | Relay K101 contacts 13 and 14; 17 and 18. Switch S104 contacts 1 and pole. |
| TELETYPE LINE 1 binding posts. | ON-OFF switch at ON. | Infinity | Switch S104 contacts and pole. |
| TELETYPE LINE 2 binding posts. | ON-OFF switch at ON. TELEPHONE switch at RADIO. ONE WAY-DUPLEX switch at DUPLEX. TELETYPE switch at RADIO. | 35 ohms (0 ohms with cable at C–808 FS KEY jack removed) | Relay K101, contacts 9 and 10; Special Purpose Cable Assembly CX–1324/U to FS KEYING jack on teletypewriter control, teletypewriter control, teletypewriter in shelter. |
| TELETYPE LINE 2 binding posts. | ON-OFF switch at ON. TELEPHONE switch at RADIO. ONE WAY-DUPLEX switch at ONE WAY. TELETYPE switch at RADIO. | 0 | Contact 5 and its pole of S102. |
| TELEPHONE binding post E107 to ring contact of J102. | Special Purpose Cable Assembly CX–2482/U removed from J102; TELEPHONE switch in RADIO posiion. | Infinity | Capacitor C101. |
| TELEPHONE binding post E108 to chassis. | Switches in any position | Infinity | Capacitor C102. |
| TELEPHONE binding post E108 to CONTROL AND TEL LINE binding post E102. | TELEPHONE switch in LOCAL position. | Infinity | Capacitor C103. |
| TELEPHONE binding posts | Switches in any position | Infinity and | Switch S101, terminals 7 and 8 and their poles. |
| TELEPHONE binding post E107 to CONTROL AND TEL LINE binding post E101. | TELEPHONE switch in RADIO position. | 12 ohms | Hybrid coil winding 7–8. |
| Tip of R–388 PHONES jack to chassis. | TELEPHONE switch in the RADIO position; Special Purpose Cable Assembly CX–2481/U removed from J101. | 2,400 ohms | R101, HY101, R102; if reading is 3,000 ohms, check HY101, terminals 1 and 2. |
| Contacts of RA–87 115–VDC jack J108. | ON-OFF switch at ON; ONE WAY-DUPLEX switch in the ONE WAY position; TELETYPE switch in the LOCAL position. | 4,900 ohms | Coil of relay K101; contacts of switches S102, S103, and S104. |

## 32. Remote Switching Control C–1307/GRA–14, Resistance Measurements

Make the measurements given in the chart below with all plugs and field wires removed from the remote switching control. Failure to obtain an indication within 10 per cent of the value means there is trouble in one or more of the parts given in the "Parts to be checked column." Use Multimeter AN/URM–105 or an equivalent meter. Refer to figure 17.

| Test points | Test conditions | Correct resistance | Part to be checked |
|---|---|---|---|
| Terminals of power plug P1 | Switch at ON or OFF | Infinity | Check line cord and plug for shorts. If less than infinity is indicated with switch at ON, check lamp and socket for shorts. |

| Test points | Test conditions | Correct resistance | Part to be checked |
|---|---|---|---|
| CONTROL AND TEL LINE binding posts. | Switch at OFF | Infinity | Switch S1. |
| | Switch at ON | 400 ohms | Choke L1. Switch S1. |
| TELETYPE LINE 1 binding posts. | Switch at ON or OFF | 0 | J1, J2, or J3. |
| TELETYPE LINE 2 binding posts. | Switch at ON or OFF | 0 | J4, J5, or J6. |
| Binding posts E8 and E1 | Switch at ON or OFF | Infinity | C1. |

# CHAPTER 4
# REPAIRS AND ALINEMENT PROCEDURES

## 33. Replacement of Parts

All parts of the teletypewriter control unit, Radio Set Control C–1306/GRA–14, and Remote Switch Control C–1307/GRA–14 can be reached easily and replaced without special procedures. For replacement techniques and special procedures for parts of all other components of Radio Set AN/GRC–26(*), refer to the applicable technical manual (TM 11–5820–202–10, par. 1*c*).

*a. Parts Replacement Techniques.*

(1) When a part contains several leads, tag each lead before unsoldering it. This permits the reconnection of the leads without constant reference to the wiring diagram.

(2) Be careful not to damage adjacent parts or wiring by pushing them out of the way.

(3) Be careful when soldering. Do not use more solder than necessary to make a secure connection. Do not permit drops of solder to fall into the equipment; they can cause trouble.

(4) Position a new part in exactly the same position as that occupied by the faulty part.

(5) Always use the same ground as used for the original wiring.

(6) When a variable resistor or potentiometer is replaced, check the circuit for proper operation and readjust the replaced part as necessary.

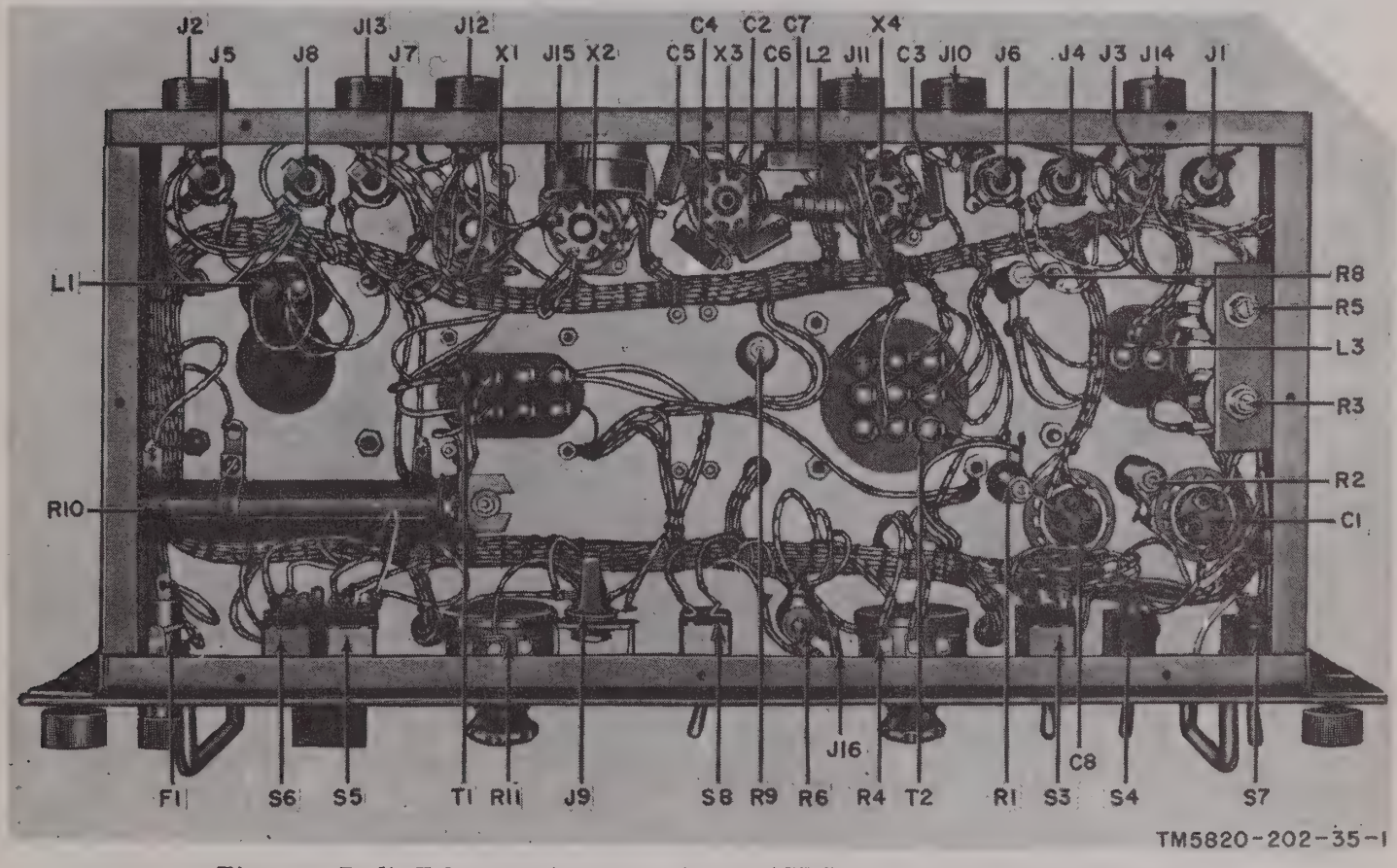



*Figure 7. Radio Teletypewriter Control C–808/GRC–26A, bottom view of chassis.*

*b. Location of Parts.*

| Component | Fig. No. |
|---|---|
| Radio Teletypewriter Control C–808/GRC–26A, bottom view of chassis. | 7 |
| Radio Teletypewriter Control C–808/GRC–26A, top view of chassis. | 8 |
| Radio Set Control C–1306/GRA–14, inside view | 9 |
| Remote Switching Control C–1307/GRA–14, inside view. | 10 |

## 34. Alinement Procedures

Adjustment procedures for the teletypewriter control unit are given in paragraph 35. Adjustment procedures for Radio Set Control Group AN/GRA–14 are given in paragraph 36. The alinement and adjustment procedures for the other components of Radio Set AN/GRC–26(*) are given in the individual technical manual (TM 11–5820–202–10, par. 1*c*).

## 35. Teletypewriter Control Unit, Adjustments

*a.* Connect a 360-ohm, 10-watt resistor and dc milliammeter (range —100 to 0 to +100) in series with terminals A and B of connector J12 (fig. 11) on the teletypewriter control unit.

*b.* Connect the teletypewriter control unit to a 115-volt 60-cps supply and operate the ON-OFF switch to the ON position.

*c.* Set the MARK and SPACE controls to their positions.

*d.* Operate the MARK-SPACE switch to the MARK position.

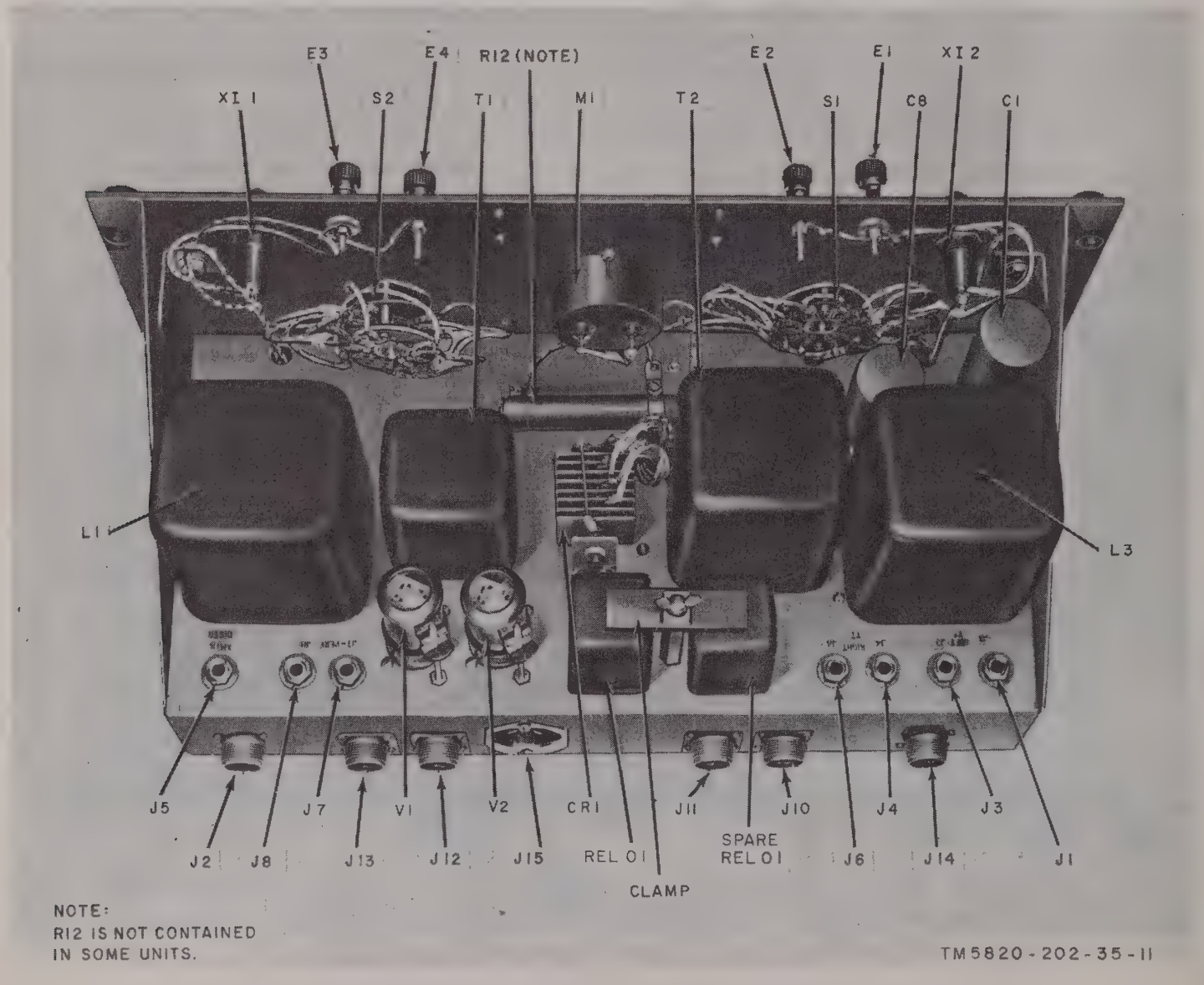



*Figure 8. Radio Teletypewriter Control C–808/GRC–26A, top view of chassis.*

*e.* Adjust the slide on resistor R10 until the meter indicates 20 ma to the right of zero.

*f.* Adjust resistor R5 until the meter M1 on the teletypewriter control unit indicates 60 to the right.

*g.* Operate the MARK-SPACE switch to the SPACE position.

*h.* Adjust resistor R3 until the meter indicates 25 ma to the left of zero. Meter M1 on the teletypewriter control unit should indicate 75 to the left of zero.

*i.* Operate the MARK-SPACE switch to the MARK position. The meter should indicate 20 ma to the right of zero. If necessary, repeat the procedures given in *c* through *f* above to obtain this indication.

*Note.* Resistor R12 is provided on some equipments so that the line current through the teletypewriter equipment can be adjusted to 60 ma when that current cannot be adjusted by using the teletypewriter line potentiometer.

## 36. Radio Set Control Group AN/GRA–14, Adjustments

After the installation is completed (TM 11-

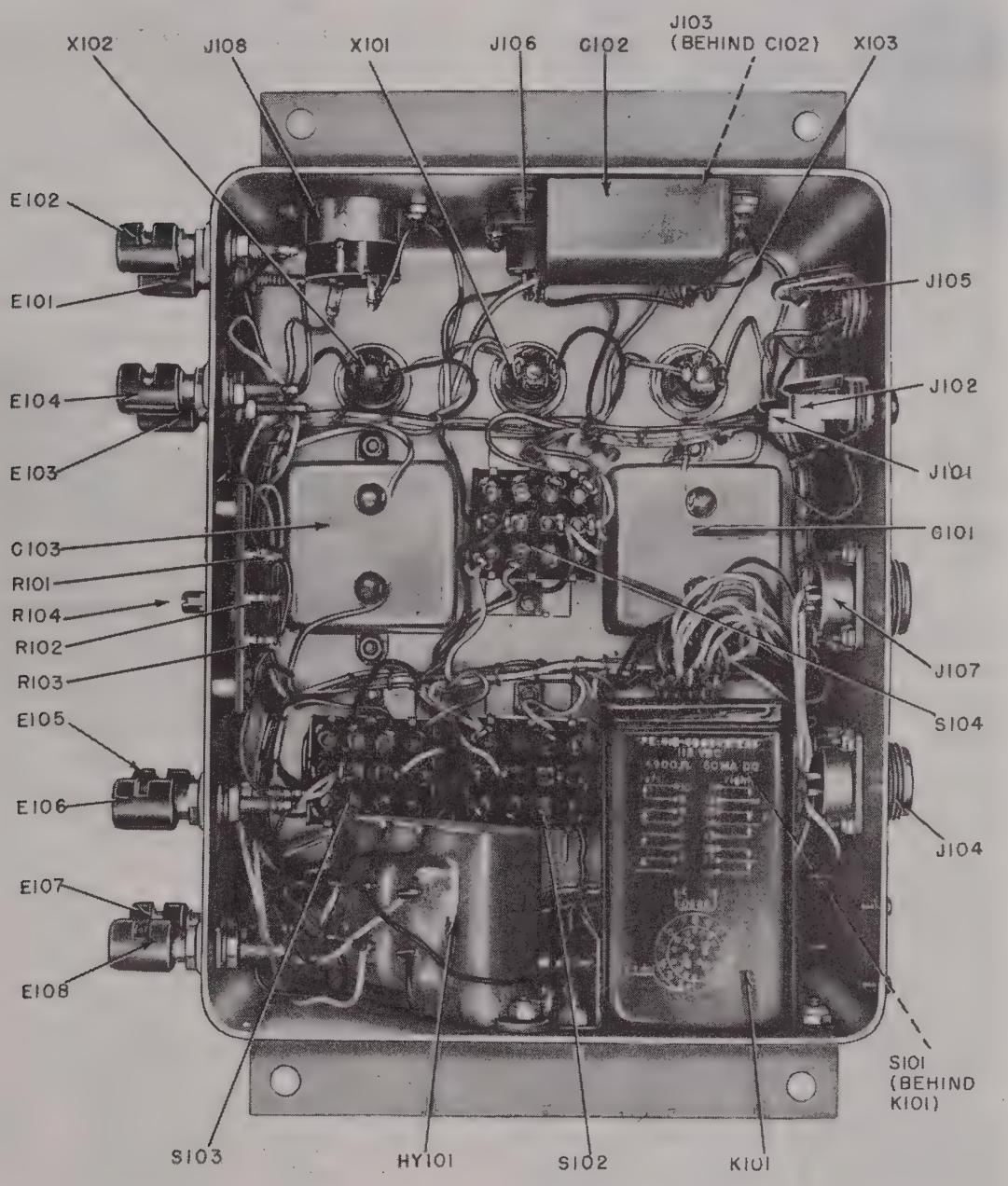



*Figure 9. Radio Set Control C–1306/GRA–14, inside view.*

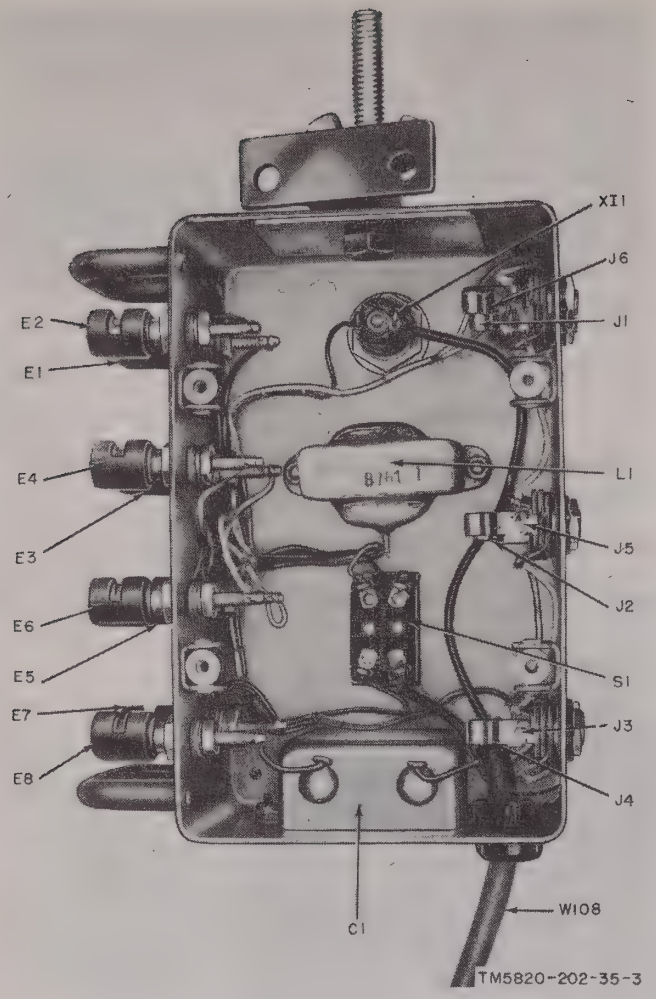



*Figure 10. Remote Switching Control C–1307/GRA–14, inside view.*

5820–202–10), make the following adjustments.

*a. Initial Switch Settings.*

(1) Operate the ON-OFF switch on the remote switching control to the OFF position.

(2) Operate the switches on the radio set control as follows:

| Switch | Position |
|---|---|
| ON-OFF | OFF |
| TELEPHONE | LOCAL |
| ONE WAY-DUPLEX | ONE WAY |
| TELETYPE | LOCAL |

*b. Telephone and Control Circuits.*

(1) In turn, ring each telephone by cranking the ringer handle. The bells should ring.

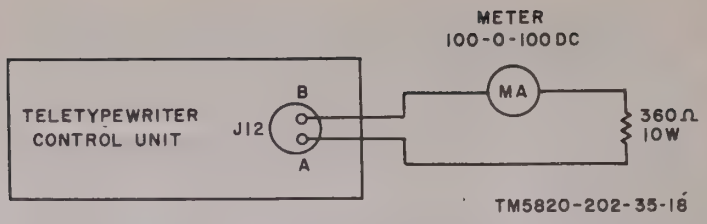



*Figure 11. Teletypewriter control unit, meter adjustment setup.*

(2) Press the handset switch on the telephone and talk over the circuit; release the handset switch to listen.

(3) With Radio Set AN/GRC–26(*) in operation (TM 11–5820–202–10), operate the ON-OFF switch and the TELETYPE switch on the radio set control to ON and RADIO positions, respectively.

(4) On the remote switching control, operate the ON-OFF switch to the ON position.

(5) The red pilot lamp on the transmitter should light, indicating that the high-voltage circuit is energized.

*c. Teletypewriter Circuits.*

(1) Operate the MOTOR switch on the teletypewriters to the ON position.

(2) Check the milliammeter on each teletypewriter for proper polarity and an indication of 60 ma.

*d. HYBRID BALANCE Control.*

(1) Operate the switches on the radio set control as indicated below.

| Switch | Position |
|---|---|
| ON-OFF | ON |
| TELEPHONE | RADIO |
| ONE WAY-DUPLEX | DUPLEX |
| TELETYPE | RADIO |

(2) Tune one of the radio receivers for a steady carrier signal.

(3) On the beat-frequency oscillator, adjust the pitch of the carrier signal for a comfortable tone.

(4) Adjust the HYBRID BALANCE control on the radio set control for a minimum indication on the meter of the speech amplifier.

# CHAPTER 5
# FINAL TESTING

## 37. Purpose of Final Testing

*a.* Final testing is designed to measure the capability of a repaired equipment. Equipment that meets the minimum standards stated in the tests will furnish satisfactory operation, equivalent to that of new equipment.

*b.* Each component of Radio Set AN/GRC–26(*) which has been repaired and has its own technical manual should be final tested in accordance with the instructions in the applicable technical manual (TM 11–5820–202–10, par. 1*c*). The teletypewriter control unit should be final tested as described in paragraphs 39 and 40. Only voltage and resistance measurements (pars. 31 and 32) are required to final test a repaired Radio Set Control C–1306/GRA–14. Only resistance measurements (par. 33) are required to final test repaired Remote Switching Control C–1307/GRA–14. Use the equipment performance check list (TM 11–5820–202–20) to final test the complete AN/GRC–26(*).

## 38. Test and Additional Equipment Required for Final Testing

The following test equipment (*a* below) and additional equipment (*b* below) are required for final testing the teletypewriter control unit. Test equipment required for final testing the other components of Radio Set AN/GRC–26(*) are listed in the applicable technical manual (App).

*b. Test Equipment.*

| Item | Common name | Technical manual |
|---|---|---|
| Multimeter AN/URM–105 or equal (Multimeter TS–352/U). | Multimeter | |
| Test Set I–193–C or equal. | Polar relay test set | TM 11–2513 |
| Voltmeter, Meter ME–30A/U or equal. | Voltmeter | TM 11–5132 |

*b. Additional Equipment.*

| Item | Federal stock No. | Quantity required |
|---|---|---|
| Ammeter (dc milliammeter) | 6625–186–8297 | 1 |
| Dummy Plugs PL–55 | 5935–192–4760 | 2 |
| Cord (patchcord) | 5995–279–1316 | 1 |
| Rectifier RA–87–(*) | 6130–230–7257 | 1 |
| Resistor, 360 ohms ±10% 5 w | 5905–243–6398 | 1 |
| Resistor, 500 ohms ±2% 4 w* | 5905–195–1821 | 3 |
| Variable transformer (Variac) CN–16/U. | 5950–235–2086 | 1 |

* The 500-ohm resistors are used to simulate the resistance of the printer magnets in the teletypewriters.

## 39. Teletypewriter Control Unit, Pretest Setup (fig. 12)

*a.* Connect the variac power cord into an 115-volt, 60-cps power supply.

*b.* Connect the output of the variac to connector J15 on the teletypewriter control unit. Adjust the output of the variac for 115 volts.

*c.* Set the switches and controls on the teletypewriter control unit as indicated in the chart below.

| Item | Position |
|---|---|
| MARK control (R11) | Mid |
| SPACE control (R4) | Mid |
| FULL DX-ONE WAY switch (S4). | FULL DX |
| MARK-SPACE switch (S8) | MARK |
| NORMAL C–W BREAK-IN switch. | C-W BREAK-IN |
| NORMAL-EXTENSION switch (S3). | NORMAL |
| ON-OFF switch (S7) | OFF |
| PERFORATOR OPERATION switch (S2). | RECEIVE TT |
| TT TRANSPOSE switch (S1) | LEFT REC-RIGHT SEND |
| XMTR ON-XMTR OFF switch (S5 and S6) | XMTR OFF |

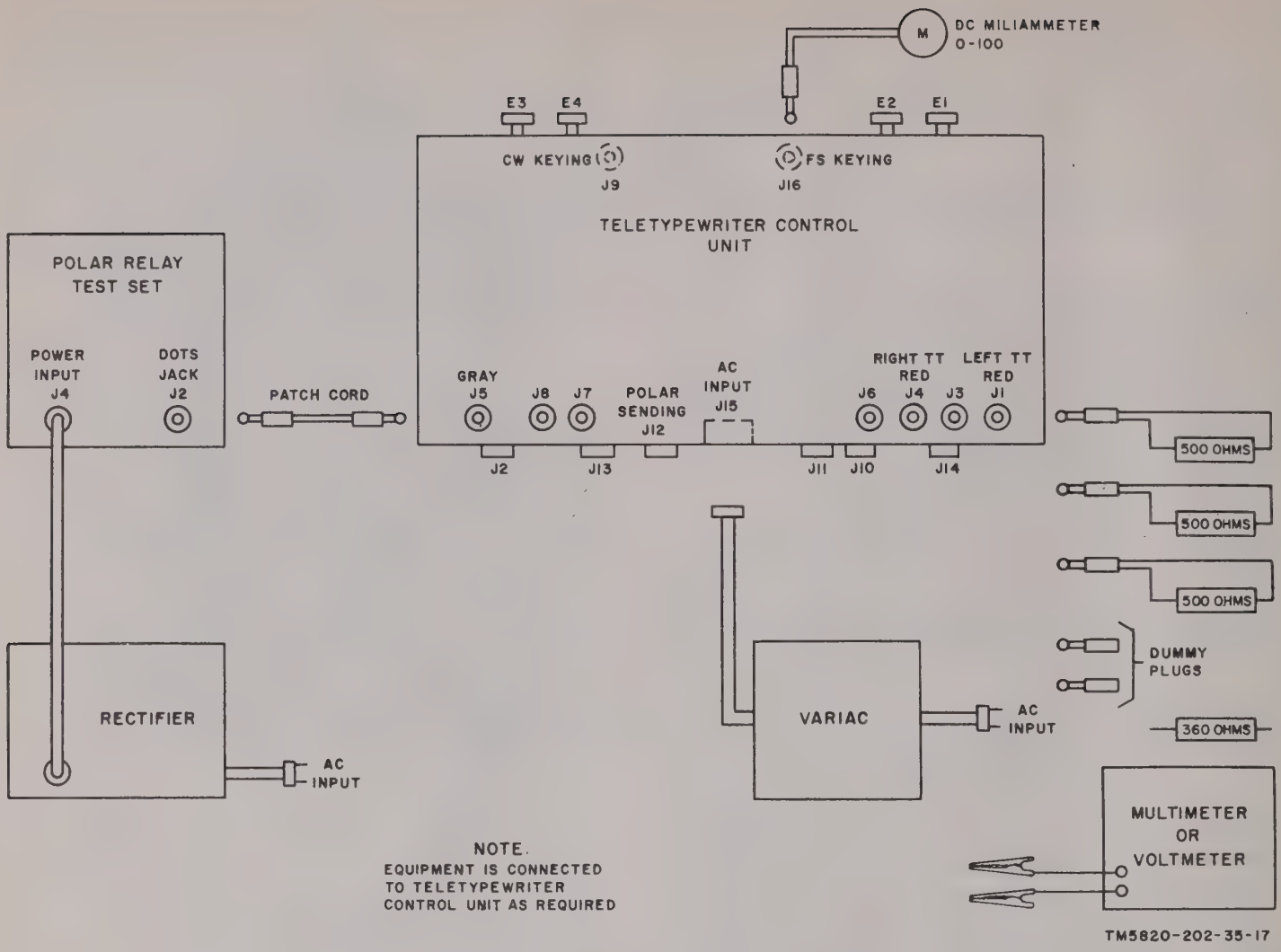



*Figure 12. Teletypewriter control unit, test setup.*

## 40. Teletypewriter Control Unit, Tests (fig. 12)

After the pretest setup (par. 39) is completed, perform the following tests on the teletypewriter control unit in the sequence given:

*a. Sending Circuit Input Current Test.*

(1) Connect one 500-ohm resistor across jack J1; connect another 500-ohm resistor across jack J4.

(2) Connect the dc milliammeter to jack J16.

(3) Operate the ON-OFF switch on the teletypewriter control unit to the ON position.

(4) Adjust potentiometer R12 (fig. 13) to obtain an indication of 60 ma on the dc milliammeter.

*Note.* In some teletypewriter control units, the input current is not adjustable; potentiometer R12 is not provided and the value of resistor R9 is 1,600 ohms. In these units, the dc milliammeter should indicate at least 50 ma.

(5) Alternate the PERFORATOR OPERATION switch between PUNCH TAPE and SEND TT positions. The dc milliammeter should not vary more than 1 ma from the indication obtained in (4) above.

(6) Restore the PERFORATOR OPERATION switch to the RECEIVE TT position.

*b. Polar Sending Current Test.*

(1) Connect a third 500-ohm resistor to jack J7.

(2) Connect the multimeter, arranged as a milliammeter, to terminals A and B of connector J12.

(3) Operate the MARK-SPACE switch to the SPACE position.

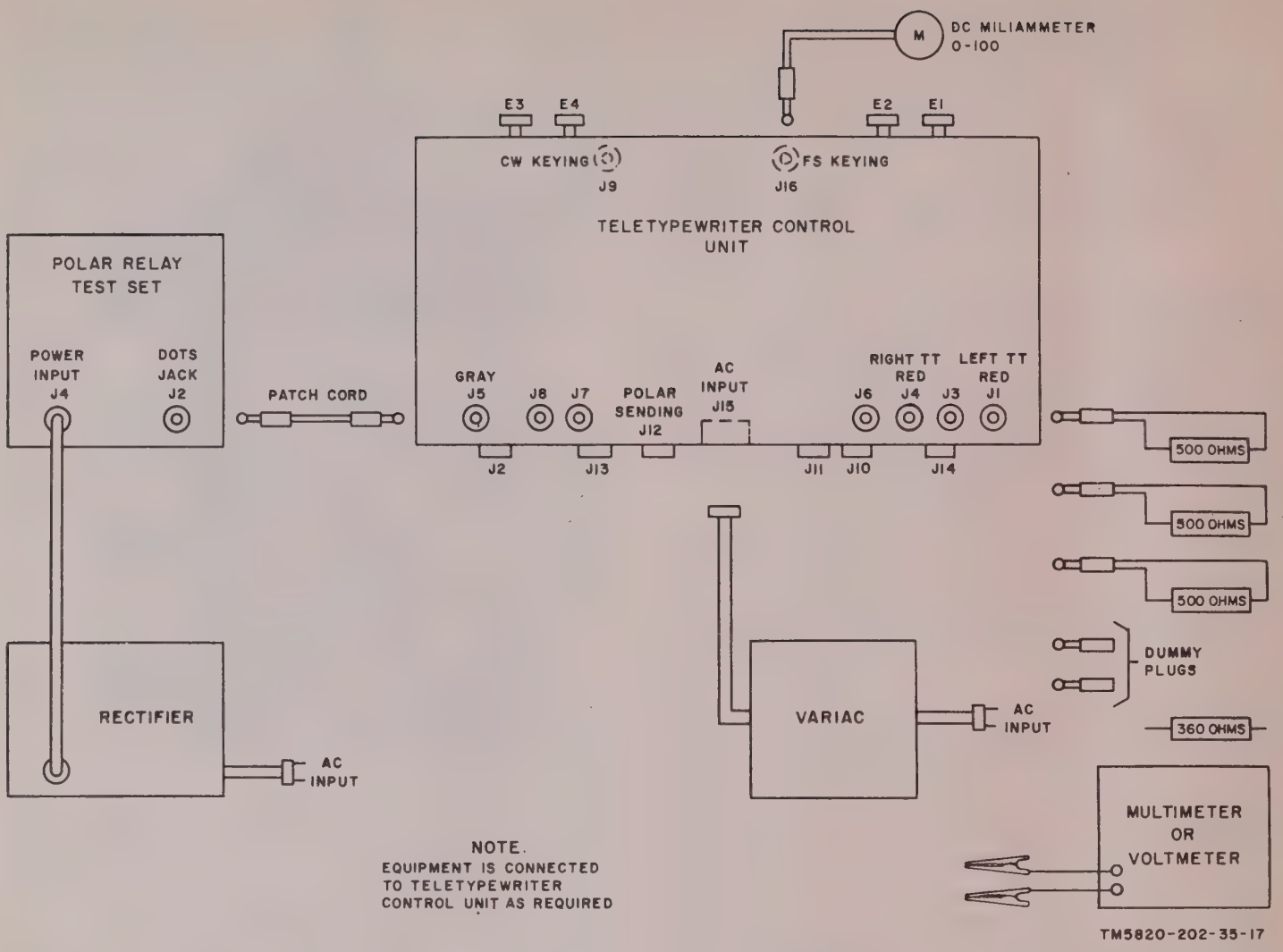



*Figure 12. Teletypewriter control unit, test setup.*

## 40. Teletypewriter Control Unit, Tests (fig. 12)

After the pretest setup (par. 39) is completed, perform the following tests on the teletypewriter control unit in the sequence given:

*a. Sending Circuit Input Current Test.*

(1) Connect one 500-ohm resistor across jack J1; connect another 500-ohm resistor across jack J4.

(2) Connect the dc milliammeter to jack J16.

(3) Operate the ON-OFF switch on the teletypewriter control unit to the ON position.

(4) Adjust potentiometer R12 (fig. 13) to obtain an indication of 60 ma on the dc milliammeter.

*Note.* In some teletypewriter control units, the input current is not adjustable; potentiometer R12 is not provided and the value of resistor R9 is 1,600 ohms. In these units, the dc milliammeter should indicate at least 50 ma.

(5) Alternate the PERFORATOR OPERATION switch between PUNCH TAPE and SEND TT positions. The dc milliammeter should not vary more than 1 ma from the indication obtained in (4) above.

(6) Restore the PERFORATOR OPERATION switch to the RECEIVE TT position.

*b. Polar Sending Current Test.*

(1) Connect a third 500-ohm resistor to jack J7.

(2) Connect the multimeter, arranged as a milliammeter, to terminals A and B of connector J12.

(3) Operate the MARK-SPACE switch to the SPACE position.

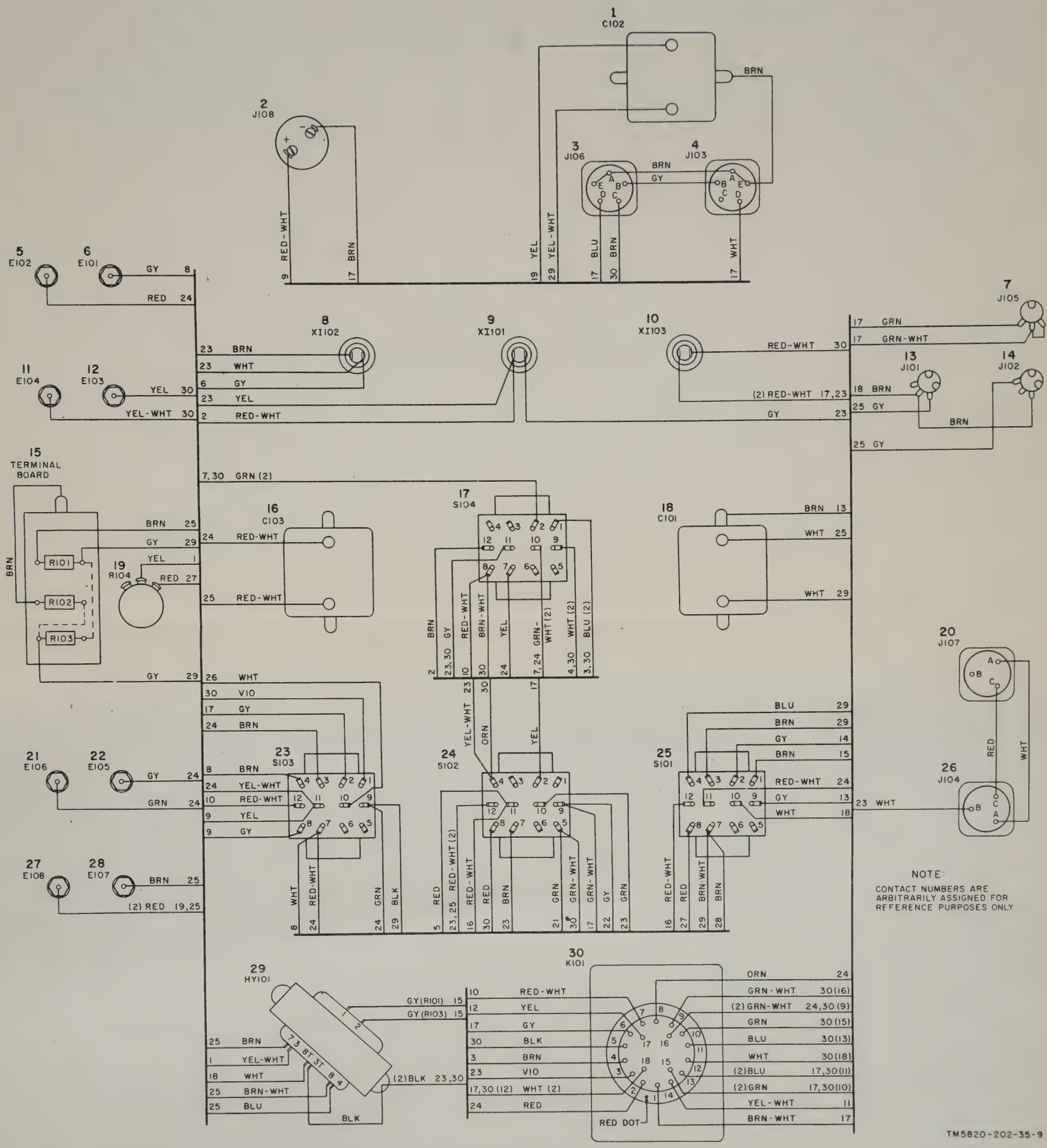
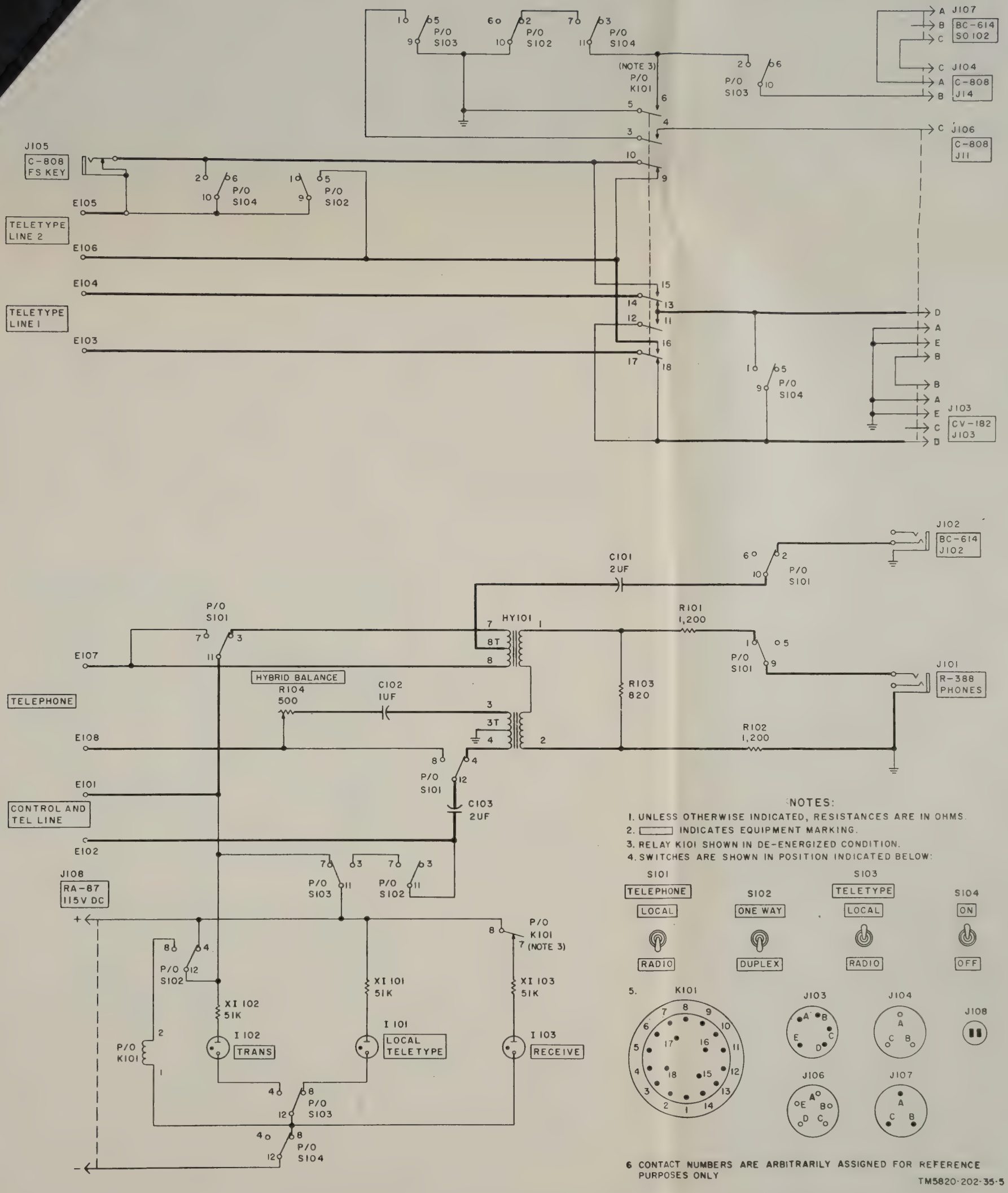



*Figure 16. Radio Set Control C–1306/GRA–14, wiring diagram.*




NOTES:

1. UNLESS OTHERWISE INDICATED, RESISTANCES ARE IN OHMS.
2. ▭ INDICATES EQUIPMENT MARKING.
3. RELAY K101 SHOWN IN DE-ENERGIZED CONDITION.
4. SWITCHES ARE SHOWN IN POSITION INDICATED BELOW:




6 CONTACT NUMBERS ARE ARBITRARILY ASSIGNED FOR REFERENCE PURPOSES ONLY

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*Figure 15. Radio Set Control C-1306/GRA-14, schematic diagram.*

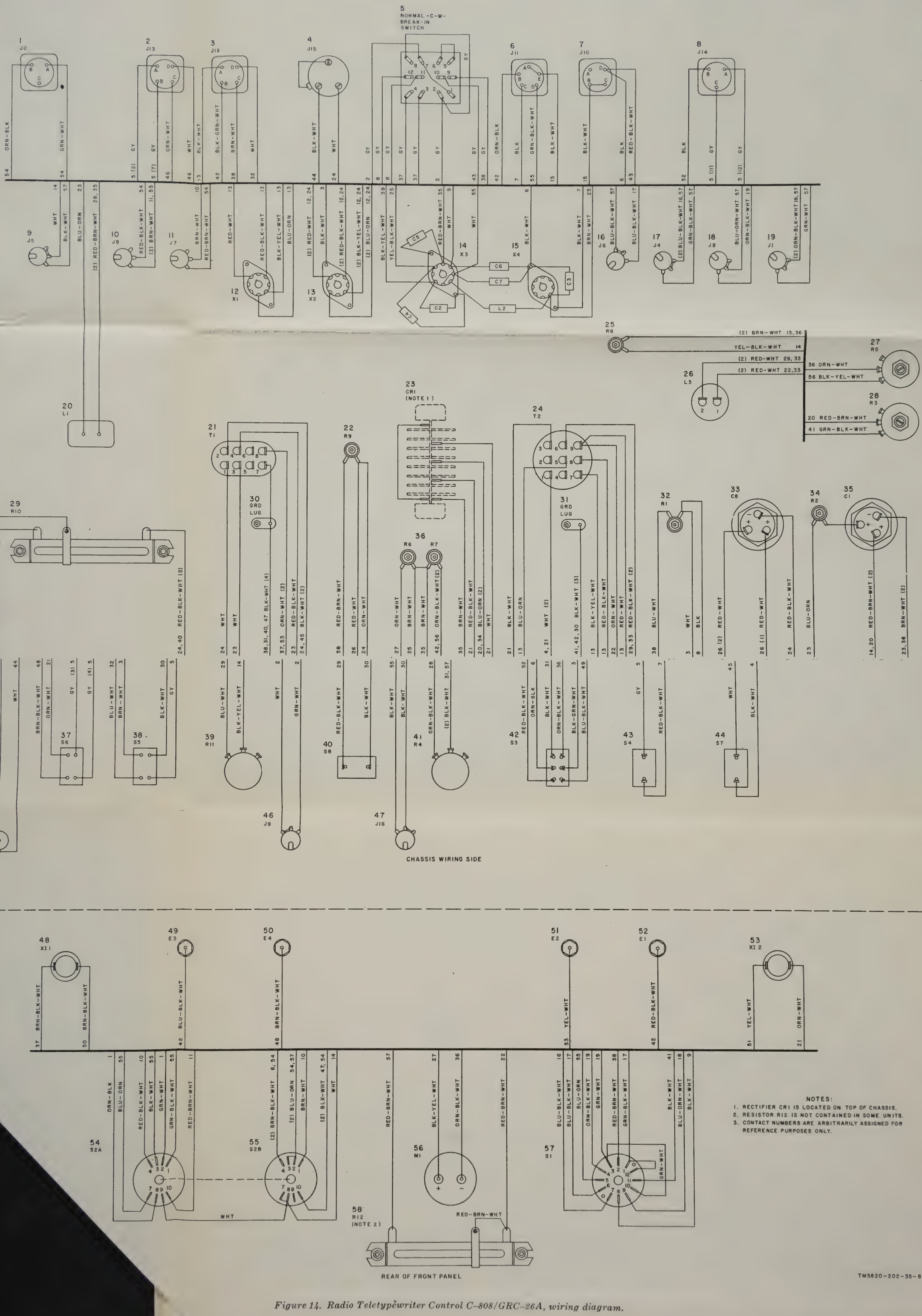
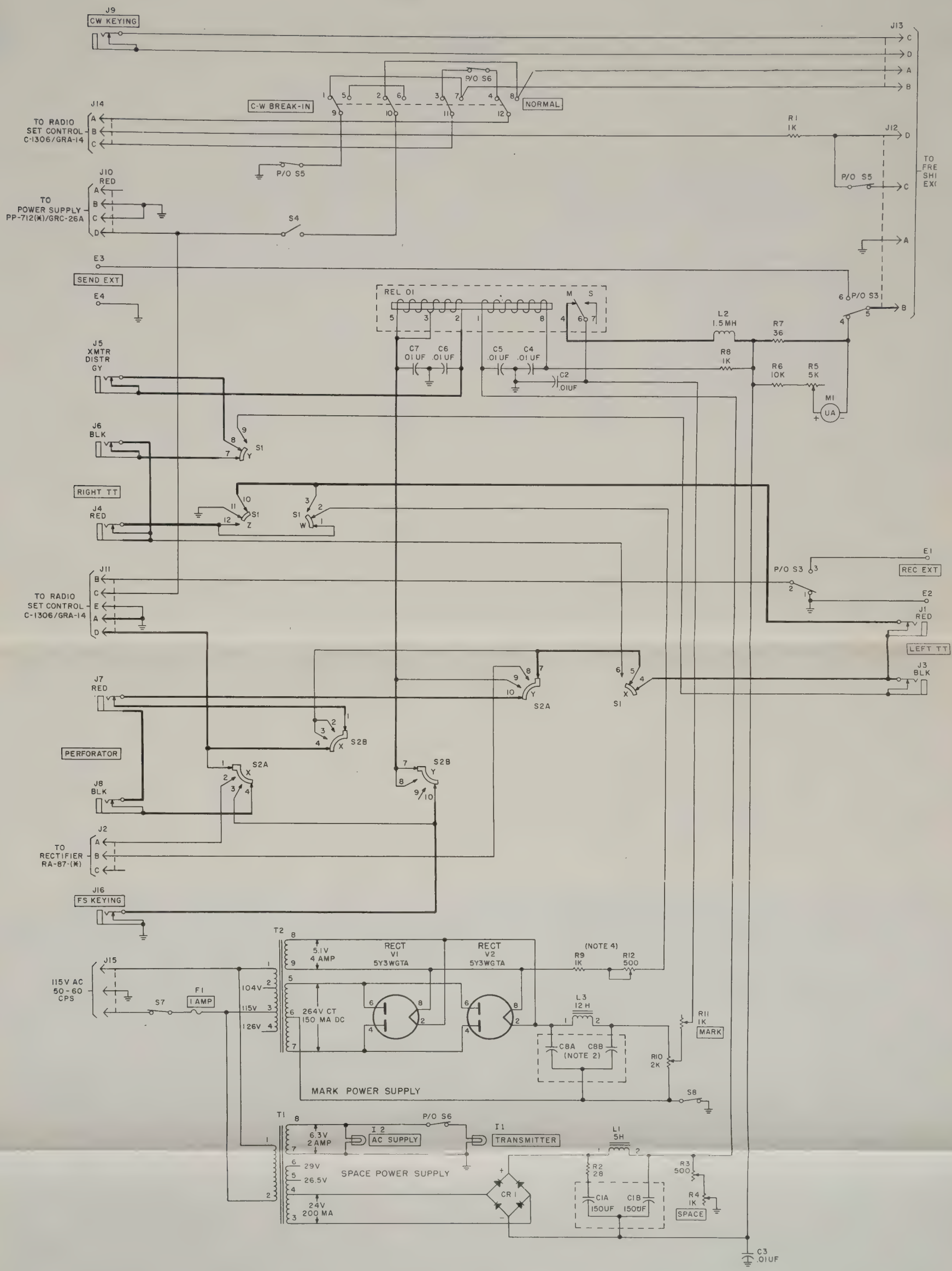
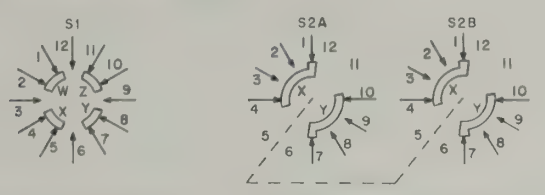



*Figure 14. Radio Teletypewriter Control C-808/GRC-26A, wiring diagram.*




NOTES:

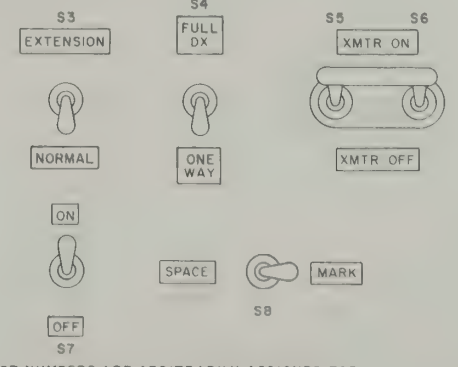
1. UNLESS OTHERWISE INDICATED, RESISTANCES ARE IN OHMS.
2. IN RADIO TELETYPEWRITER CONTROL C-808/GRC-26A, EACH SECTION OF C8 IS 25UF. IN TRANSMITTER-TELETYPEWRITER CONTROL C-808A/GRC-26A, EACH SECTION OF C8 IS 30UF.
3. WAFER SWITCH SECTIONS ARE VIEWED FROM END OPPOSITE THE CONTROL KNOB. SWITCH S1 IS SHOWN IN THE LEFT REC RIGHT SEND POSITION. SWITCH S2 IS SHOWN IN THE RECEIVE TT POSITION.




| TT TRANSPOSE S1 | |
|---|---|
| TERM | DESIGNATION |
| 1-4-7-10 | LEFT REC RIGHT SEND |
| 3-6-9-12 | RIGHT REC LEFT SEND |

| PERFORATOR OPERATION S2 | |
|---|---|
| TERM | DESIGNATION |
| 3-9 | SEND TT |
| 2-8 | PUNCH TAPE |
| 1-7 | RECEIVE TT |

4. RESISTOR R12 IS NOT CONTAINED IN SOME UNITS; RESISTOR R9 IS 1,600 OHMS.
5. SWITCHES ARE SHOWN IN POSITION INDICATED BELOW:




6. CONTACT NUMBERS ARE ARBITRARILY ASSIGNED FOR REFERENCE PURPOSES ONLY.

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*Figure 13. Radio Teletypewriter Control C–808/GRC–26A, schematic diagram.*

(4) Adjust potentiometer R3 to obtain an indication of 25 ma on the multimeter. Disregard the indication on meter M1 of the teletypewriter control unit at this time.

(5) Operate the MARK-SPACE switch to the MARK position.

(6) Adjust potentiometer R5 until meter M1 on the teletypewriter control unit indicates 60 to the right.

(7) Operate the MARK-SPACE switch to the SPACE position. The multimeter should indicate 25 ma ±1 ma; meter M1 on the teletypewriter control unit should indicate 75 ±3 to the left.

(8) Restore the MARK-SPACE switch to the MARK position. Disconnect the multimeter.

*c. Ripple Voltage Test.*

(1) Connect the voltmeter, paralleled by the 360-ohm resistor, across terminals A and B of connector J12.

(2) The voltmeter should not indicate more than 10 millivolts (ripple voltage).

(3) Disconnect the voltmeter and 360-ohm resistor.

*d. Polar Sending Bias Check.*

(1) Connect the multimeter, arranged as a milliammeter, to terminals A and B of connector J12.

(2) Rotate the SPACE control to the fully counterclockwise position.

(3) Operate the MARK-SPACE switch to the SPACE position.

(4) Record the indication of meter M1 on the teletypewriter control unit.

(5) Operate the MARK-SPACE switch to the MARK position.

(6) Adjust the MARK control until meter M1 on the teletypewriter control unit indicates the same as recorded in (4) above.

(7) Connect the rectifier power cord into an 115-volt, 60-cps power supply.

(8) Connect the polar relay test set to the rectifier.

(9) With the patch cord, connect DOTS jack J2 on the polar relay test set to jack J5 on the teletypewriter control unit.

(10) Adjust the polar relay test set to send dots high (TM 11–2513).

(11) Meter M1 on the teletypewriter control unit should vibrate at zero. If necessary, adjust potentiometer R3 to obtain the zero indication.

(12) Alternate the TT TRANSPOSE switch between the LEFT REC RIGHT SEND and RIGHT REC LEFT SEND positions. Meter M1 should continue to vibrate about zero.

(13) Restore the TT TRANSPOSE switch to the LEFT REC RIGHT SEND position.

(14) Operate the PERFORATOR OPERATION switch to the SEND TT position.

(15) Insert dummy plugs into jacks J6 and J8.

(16) The dc milliammeter should indicate 0 ma and meter M1 on the teletypewriter control unit should indicate to the left (space current).

(17) Operate the TT TRANSPOSE switch to the RIGHT REC LEFT SEND position.

(18) Remove the dummy plug for jack J6 and insert it into jack J3.

(19) The dc milliammeter should indicate 0 ma and meter M1 on the teletypewriter control unit should indicate to the left (space current).

(20) Remove the dummy plugs and resistors. Disconnect the rectifier, polar relay test set, dc milliammeter, and variac from the teletypewriter control unit.

*e. Neutral Receiving Loop Continuity Test.*

(1) Connect the multimeter, arranged as an ohmmeter, to terminals D and E of connector J11.

(2) Operate the switches, and insert the dummy plugs and 500-ohm resistors as indicated in the chart below to obtain the multimeter indications.

| Item No. | PERFORATOR OPERATION switch position | TT TRANSPOSE switch position | Dummy plug inserted in jack | 500-ohm resistor inserted in jack | Multimeter indication (ohms) |
|---|---|---|---|---|---|
| 1 | RECEIVE TT | Either | J7 | | Infinity |
| 2 | RECEIVE TT | Either | J8 | J1, J4, and J7 | 1,000 |
| 3 | RECEIVE TT | RIGHT REC LEFT SEND | J4 | | Infinity |
| 4 | RECEIVE TT | RIGHT REC LEFT SEND | J6 | J4 and J7 | 1,000 |
| 6 | RECEIVE TT | RIGHT REC LEFT SEND | J1 | | Infinity |
| 5 | RECEIVE TT | RIGHT REC LEFT SEND | J3 | J1 and J7 | 1,000 |
| 7 | PUNCH TAPE | RIGHT REC LEFT SEND | J3 | J1 | 500 |
| 8 | PUNCH TAPE | RIGHT REC LEFT SEND | J6 | J4 | 500 |

(3) Disconnect the multimeter, dummy plugs, and resistors from the teletypewriter control unit. Restore the switches to their pretest setup position (par. 39*c*).

*f. Polar Receiving Loop Continuity Test.*

(1) Connect the multimeter, arranged as an ohmmeter, to terminals A and B of connector J11.

(2) Operate the NORMAL-EXTENSION switch to the NORMAL position.

(3) The multimeter should indicate zero resistance.

(4) Operate the NORMAL-EXTENSION switch to the EXTENSION position.

(5) The multimeter should indicate infinity.

(6) Reconnect the multimeter to binding post E1 and the chassis of the teletypewriter control unit.

(7) The multimeter should indicate infinity.

(8) Disconnect the multimeter.

*g. Punch Tape Circuit Continuity Test.*

(1) Connect the multimeter, arranged as an ohmmeter, to terminals A and B of connector J2.

(2) Operate the PERFORATOR OPERATION switch to the PUNCH TAPE position.

(3) The multimeter should indicate zero resistance.

(4) Insert a dummy plug into jack J8.

(5) The multimeter should indicate infinity.

(6) Remove the dummy plug.

(7) Reconnect the multimeter to terminal A of connector J2 and the chassis of the teletypewriter control unit.

(8) The multimeter should indicate infinity.

(9) Disconnect the multimeter.

*h. Miscellaneous Continuity Tests.* After each group of measurements has been obtained for a particular item, restore the switches to their pretest setup position (par. 39*c*).

| Item No. | Connect multimeter to | Switch | Operate to | Multimeter indication (ohms) |
|---|---|---|---|---|
| 1 | Terminal A of connector J13 and terminal D of connector J10. | FULL DX–ONE WAY | FULL DX | Infinity |
| | | NORMAL-C-W BREAK-IN | C-W BREAK-IN | Infinity |
| | | FULL DX–ONE WAY | ONE WAY | Zero |
| | | NORMAL-C-W BREAK-IN | NORMAL | Infinity |
| 2 | Terminals C and D of connector J12. | XMTR ON–XMTR OFF | XMTR ON | 1,000 |
| | | XMTR ON–XMTR OFF | XMTR OFF | Infinity |
| 3 | Terminals A and C of connector J14. | XMTR ON–XMTR OFF | XMTR ON | Zero |
| | | NORMAL-C-W BREAK-IN | NORMAL | Infinity |
| | | NORMAL-C-W BREAK-IN | C-W BREAK-IN | |
| | | XMTR ON–XMTR OFF | XMTR OFF | Infinity |
| 4 | Terminals A of connector J13 and J14. | NORMAL-C-W BREAK-IN | C-W BREAK-IN | Infinity |
| | | NORMAL-C-W BREAK-IN | NORMAL | Zero |

| Item No. | Connect multimeter to | Switch | Operate to | Multimeter indication (ohms) |
|---|---|---|---|---|
| 5 | Terminal B of connector J13 and terminal C of connector J14. | NORMAL-C-W BREAK-IN | C-W BREAK-IN | Infinity |
| | | NORMAL-C-W BREAK-IN | NORMAL | Zero |
| 6 | Terminal B of connector J13 and chassis of teletypewriter control unit. | NORMAL-EXTENSION | NORMAL | Infinity |
| | | XMTR ON–XMTR OFF | XMTR ON | Infinity |
| | | NORMAL-C-W BREAK-IN | C-W BREAK-IN | Zero |
| | | XMTR ON–XMTR OFF | XMTR OFF | Infinity |
| 7 | Terminal B of connector J14 and terminal D of connector J12. | | | |
| 8 | Terminal B of connector J14 and terminal C of connector J12. | XMTR ON–XMTR OFF | XMTR ON | Zero |
| | | XMTR ON–XMTR OFF | XMTR OFF | Infinity |
| 9 | Terminals B and C of connector J13. | ---------- | ---------- | Zero |
| 10 | Terminal B of connector J11 and binding posts E1 (REC EXT). | NORMAL-EXTENSION | NORMAL | Infinity |
| | | NORMAL-EXTENSION | EXTENSION | Zero |
| 11 | Terminal B of connector J11 and chassis of teletypewriter control unit. | NORMAL-EXTENSION | NORMAL | Zero |
| | | NORMAL-EXTENSION | EXTENSION | Infinity |
| 12 | Terminal B of connector J12 and binding post E3 (REC EXT). | NORMAL-EXTENSION | NORMAL | Infinity |
| | | NORMAL-EXTENSION | EXTENSION | Zero |

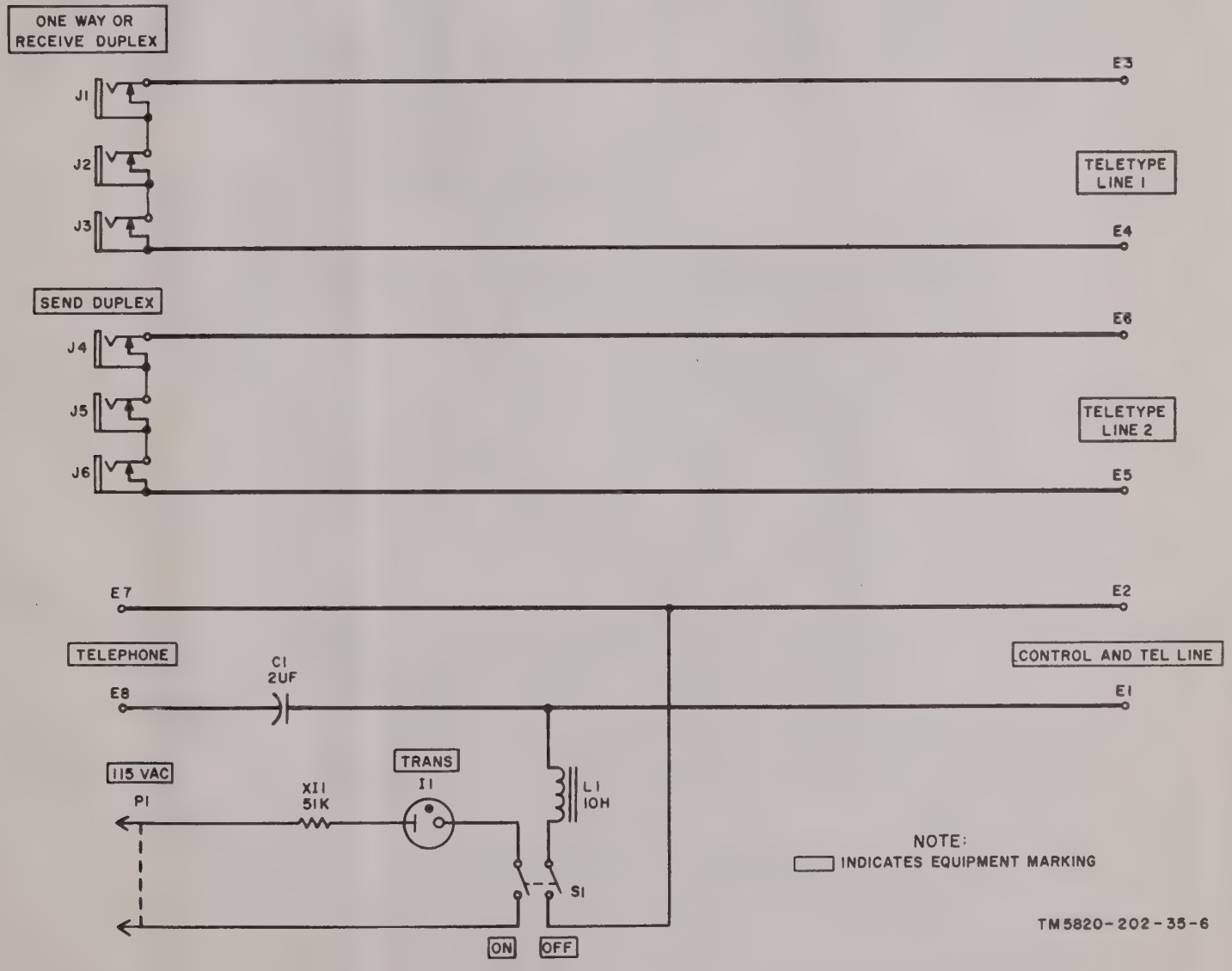



*Figure 17. Remote Switching Control C–1307/GRA–14, schematic diagram.*

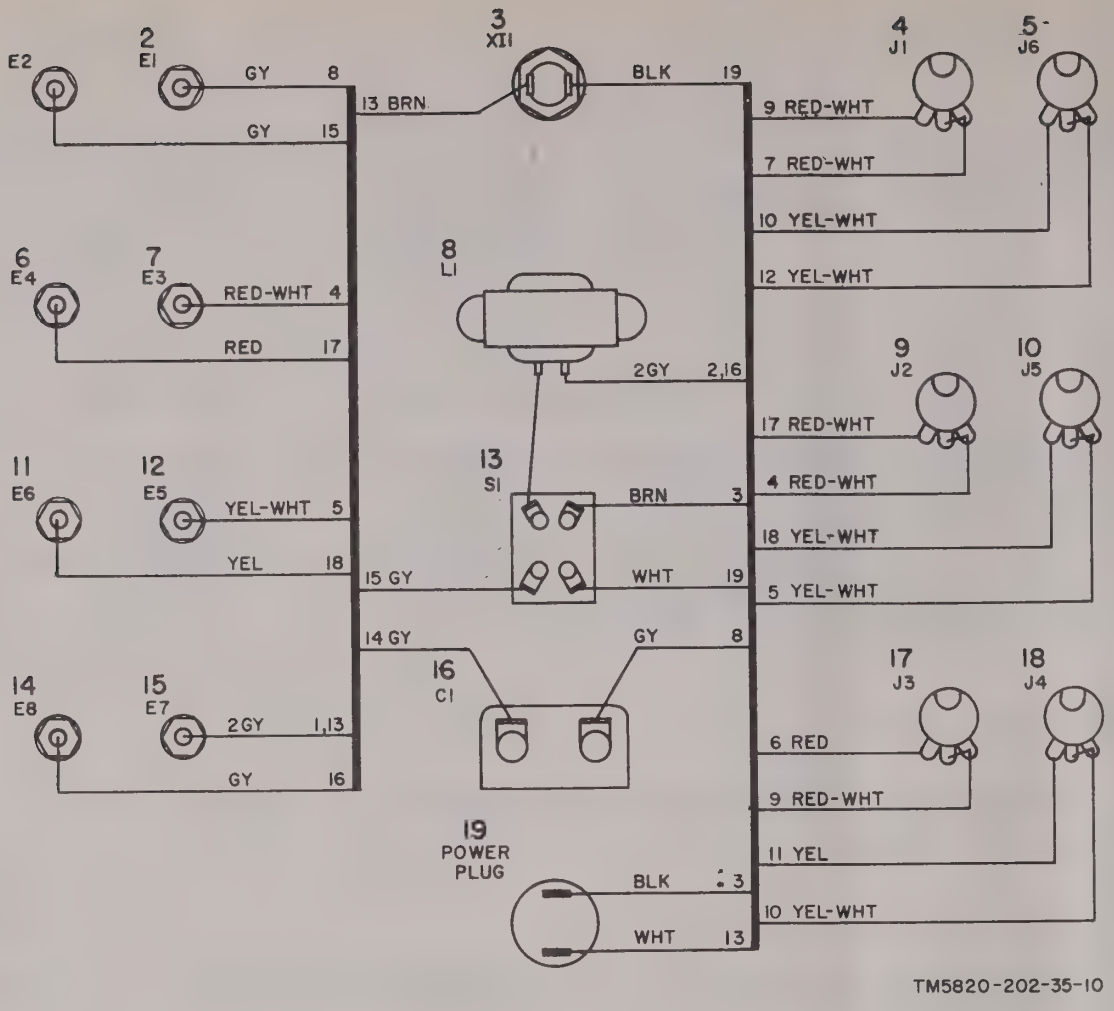



*Figure 18. Remote Switching Control C–1307/GRA–14, wiring diagram.*

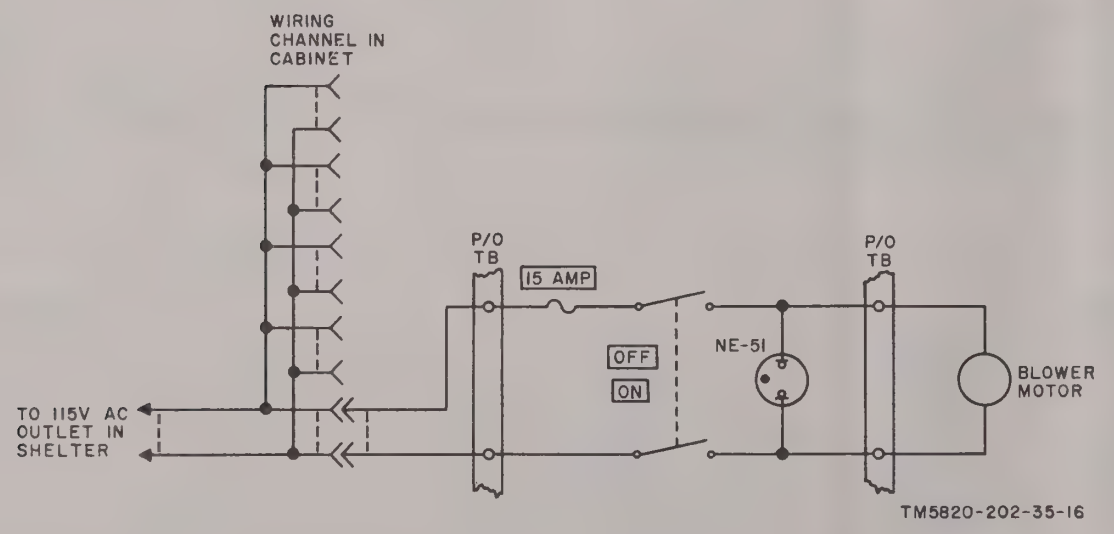
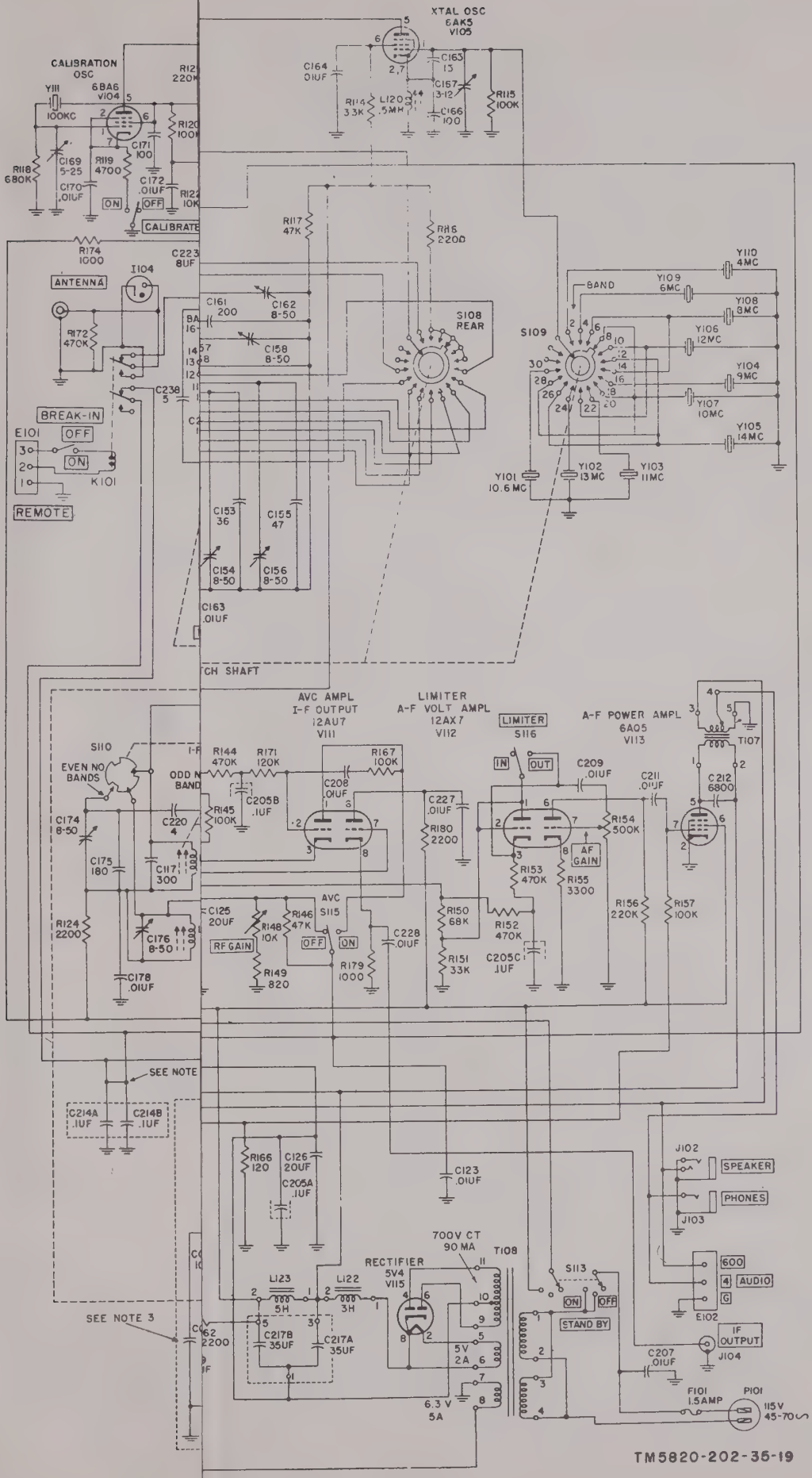



*Figure 19. Electrical Equipment Cabinet CY–1216/U, schematic diagram.*

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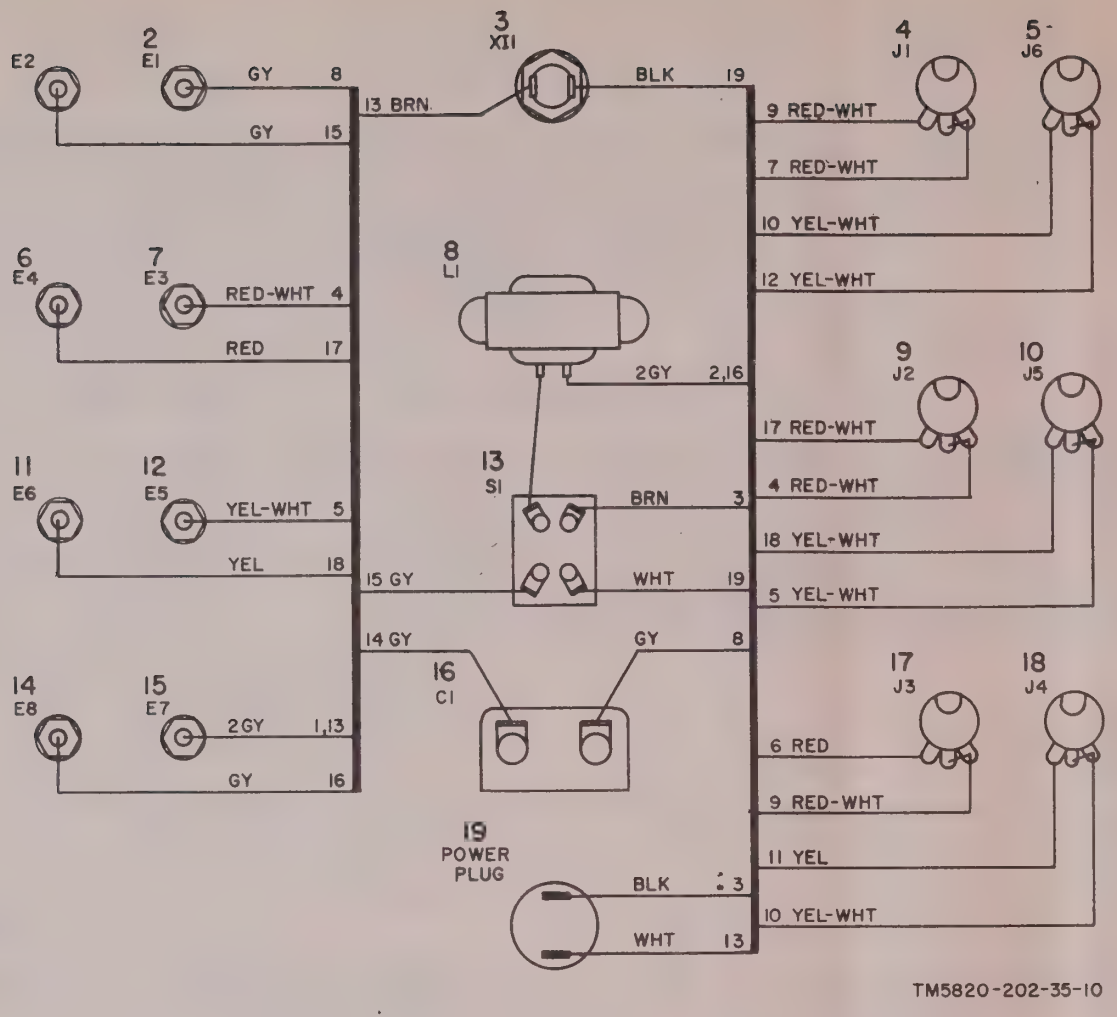



*Figure 18. Remote Switching Control C–1307/GRA–14, wiring diagram.*

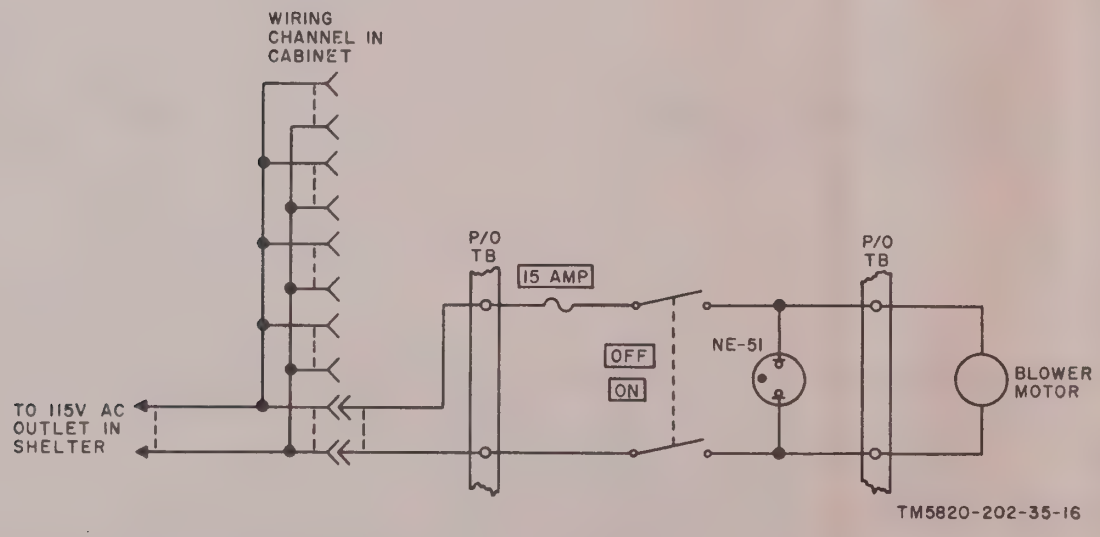
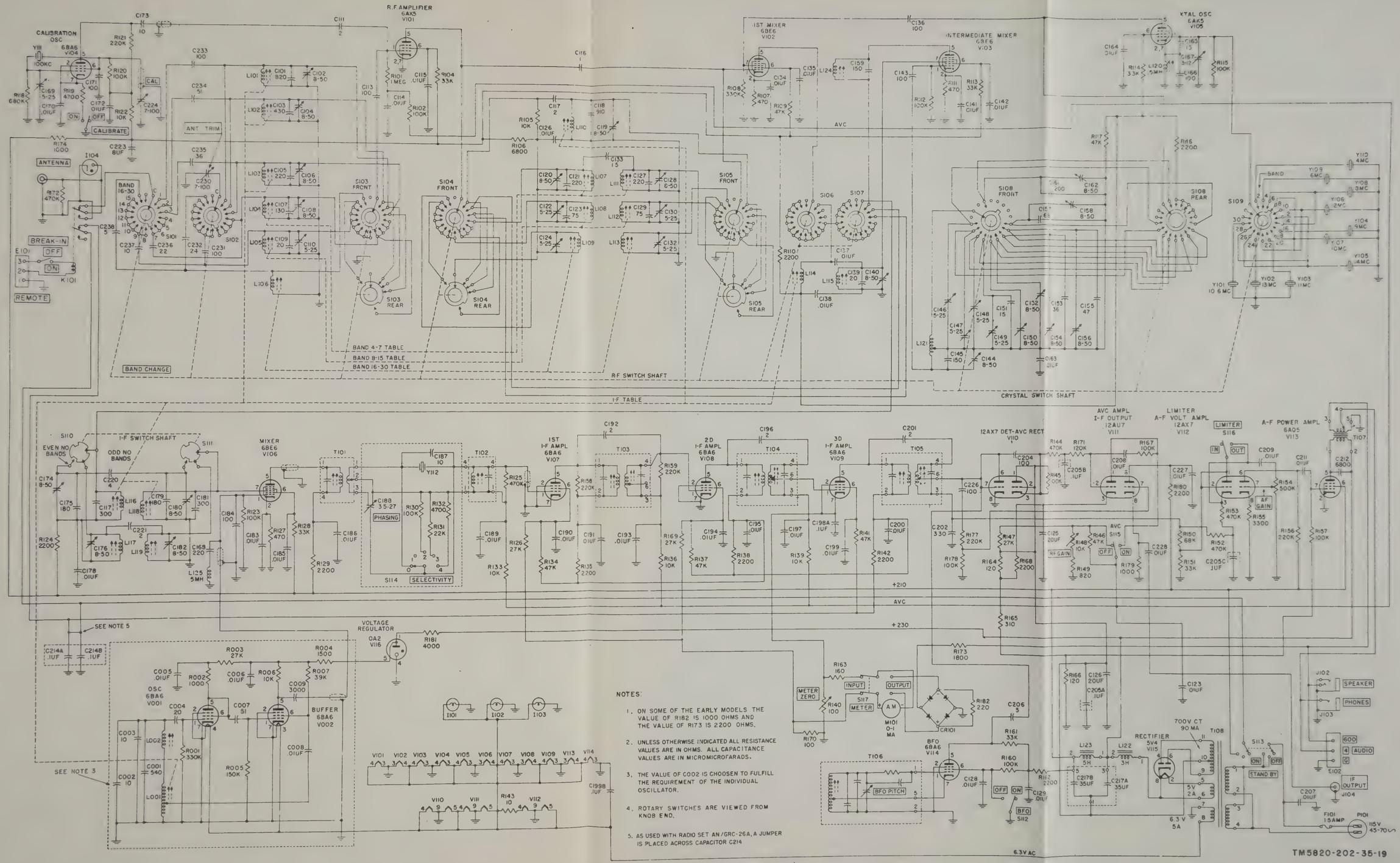



*Figure 19. Electrical Equipment Cabinet CY–1216/U, schematic diagram.*




NOTES:

1. ON SOME OF THE EARLY MODELS THE VALUE OF R182 IS 1000 OHMS AND THE VALUE OF R173 IS 2200 OHMS.
2. UNLESS OTHERWISE INDICATED ALL RESISTANCE VALUES ARE IN OHMS. ALL CAPACITANCE VALUES ARE IN MICROMICROFARADS.
3. THE VALUE OF C002 IS CHOOSEN TO FULFILL THE REQUIREMENT OF THE INDIVIDUAL OSCILLATOR.
4. ROTARY SWITCHES ARE VIEWED FROM KNOB END.
5. AS USED WITH RADIO SET AN/GRC-26A, A JUMPER IS PLACED ACROSS CAPACITOR C214

*Figure 20. Radio Receiver R-388/URR (modified), schematic diagram.*

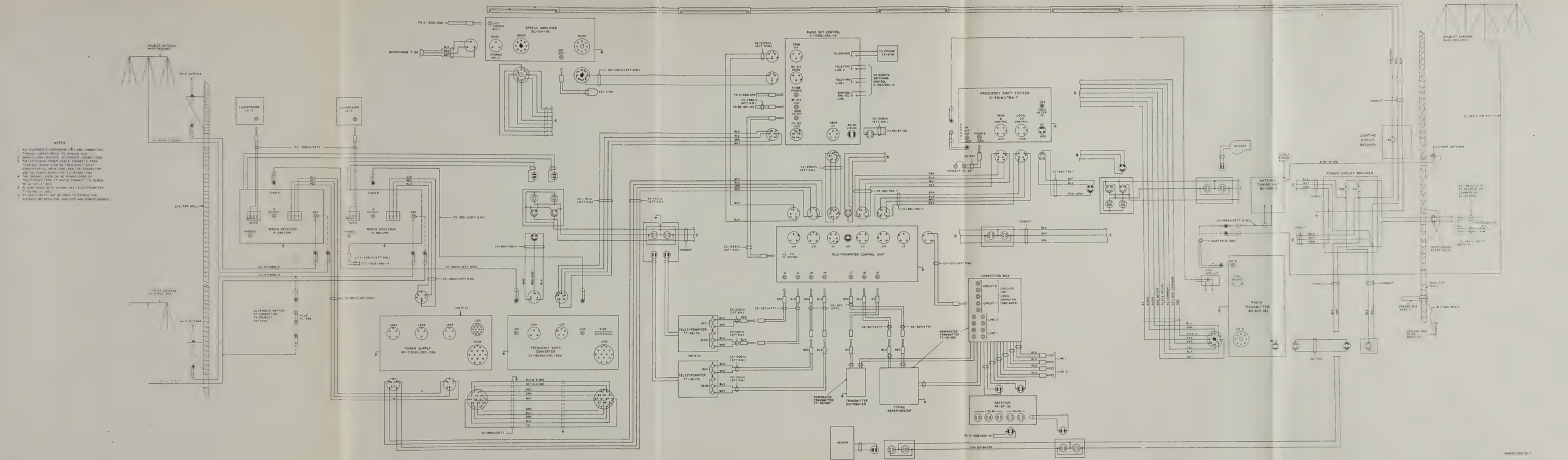
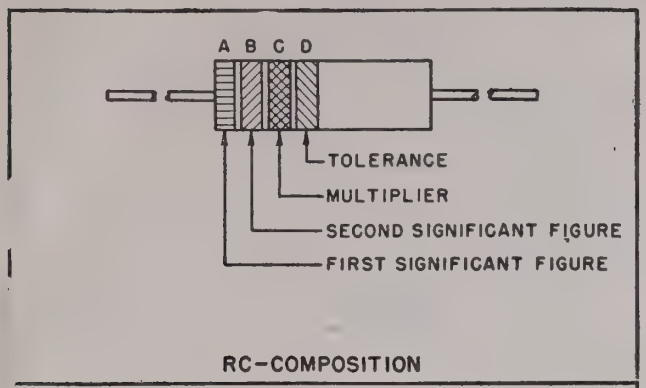


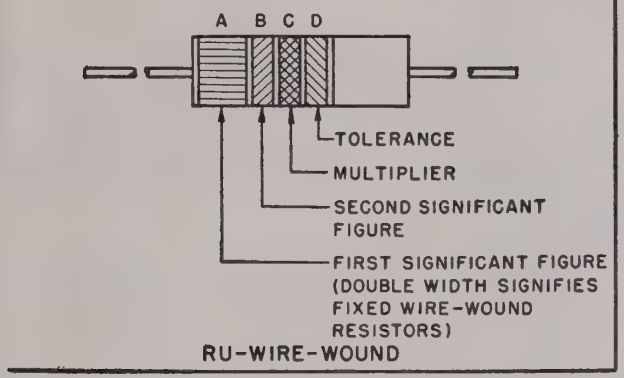

*Figure 21. Radio Set AN/GRC-26(*), interconnection schematic-wiring diagram.*

# RESISTOR COLOR CODE MARKING
## (MIL-STD RESISTORS)

### AXIAL-LEAD RESISTORS (INSULATED)

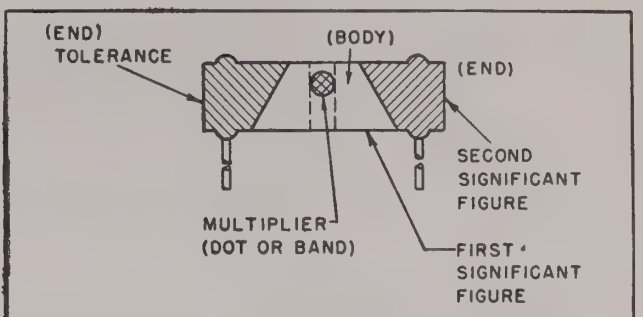



RC-COMPOSITION

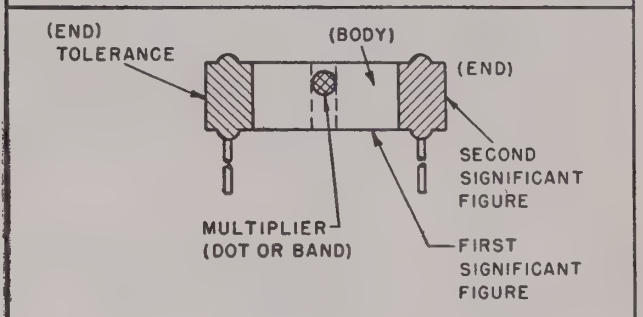



RU-WIRE-WOUND

### RADIAL-LEAD RESISTORS (UNINSULATED)




RZ-COMPOSITION




RZ-COMPOSITION

## RESISTOR COLOR CODE

| BAND A OR BODY* | | BAND B OR END* | | BAND C OR DOT OR BAND* | | BAND D OR END* | |
|---|---|---|---|---|---|---|---|
| COLOR | FIRST SIGNIFICANT FIGURE | COLOR | SECOND SIGNIFICANT FIGURE | COLOR | MULTIPLIER | COLOR | RESISTANCE TOLERANCE (PERCENT) |
| BLACK | 0 | BLACK | 0 | BLACK | 1 | BODY | ± 20 |
| BROWN | 1 | BROWN | 1 | BROWN | 10 | SILVER | ± 10 |
| RED | 2 | RED | 2 | RED | 100 | GOLD | ± 5 |
| ORANGE | 3 | ORANGE | 3 | ORANGE | 1,000 | | |
| YELLOW | 4 | YELLOW | 4 | YELLOW | 10,000 | | |
| GREEN | 5 | GREEN | 5 | GREEN | 100,000 | | |
| BLUE | 6 | BLUE | 6 | BLUE | 1,000,000 | | |
| PURPLE (VIOLET) | 7 | PURPLE (VIOLET) | 7 | | | | |
| GRAY | 8 | GRAY | 8 | GOLD | 0.1 | | |
| WHITE | 9 | WHITE | 9 | SILVER | 0.01 | | |

*FOR WIRE-WOUND-TYPE RESISTORS, BAND A SHALL BE DOUBLE-WIDTH. WHEN BODY COLOR IS THE SAME AS THE DOT (OR BAND) OR END COLOR, THE COLORS ARE DIFFERENTIATED BY SHADE, GLOSS, OR OTHER MEANS.

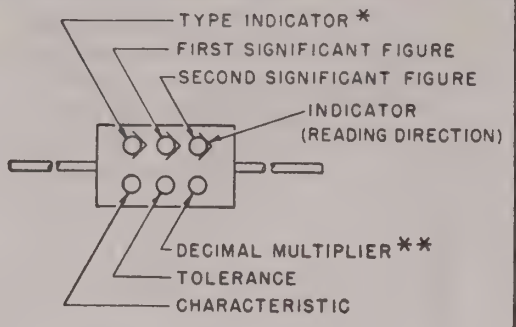
XAMPLES (BAND MARKING):
10 OHMS ±20 PERCENT: BROWN BAND A; BLACK BAND B; BLACK BAND C; NO BAND D.
4.7 OHMS ±5 PERCENT: YELLOW BAND A; PURPLE BAND B; OLD BAND C; GOLD BAND D.

EXAMPLES (BODY MARKING):
10 OHMS ±20 PERCENT: BROWN BODY; BLACK END; BLACK DOT OR BAND; BODY COLOR ON TOLERANCE END.
3,000 OHMS ±10 PERCENT: ORANGE BODY; BLACK END; RED DOT OR BAND; SILVER END.

STD-RI

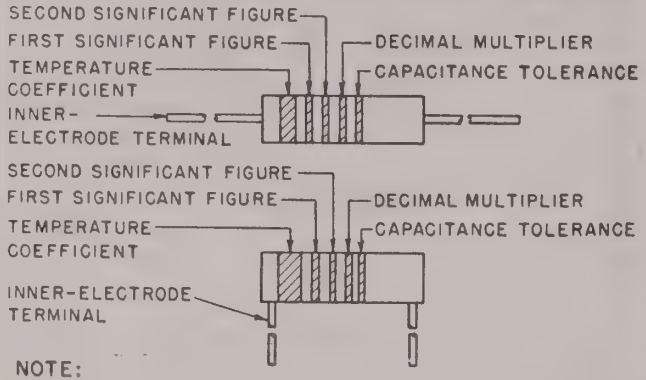
*Figure 22. Resistor color code marking.*

## CAPACITOR COLOR CODE MARKING
## (MIL-STD CAPACITORS)



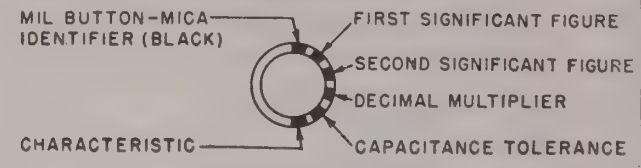

* BLACK DOT: MICA DIELECTRIC
SILVER DOT: PAPER DIELECTRIC
**INDICATES NUMBER OF ZEROS ON PAPER TYPE.

MICA (CM) AND PAPER (CN)

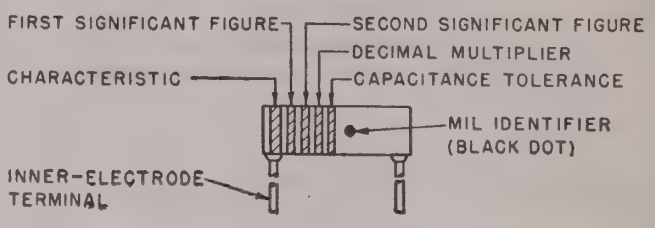


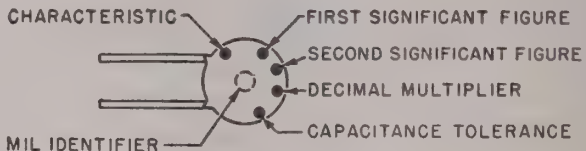

NOTE:
SPOTS MAY BE USED INSTEAD OF BANDS; TEMPERATURE COEFFICIENT MARKING IS LARGER.

CERAMIC-TEMPERATURE COMPENSATING (CC)




BUTTON-MICA (CB)




NOTES:
1. SPOTS MAY BE USED ON TUBULAR CAPACITORS; CHARACTERISTIC SPOT IS LARGER AND MIL IDENTIFIER IS ON SIDE DIAMETRICALLY OPPOSITE COLOR SPOTS.
2. MIL IDENTIFIER OF DISK TYPE IS ON REVERSE SIDE; CHARACTERISTIC SPOT IS LARGER OR SPACE BETWEEN CHARACTERISTIC AND TOLERANCE SPOTS IS THREE TIMES SPACE BETWEEN ADJACENT SPOTS.
3. TOLERANCE: YELLOW, +100%, −20%.

CERAMIC-GENERAL PURPOSE (CK)

## CAPACITOR COLOR CODE

| COLOR | SIG FIG. | MULTIPLIER | | CHARACTERISTIC[1] | | | | TOLERANCE [2] | | | | | TEMPERATURE COEFFICIENT (UUF/UF/°C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | DECIMAL | NUMBER OF ZEROS | CM | CN | CB | CK | CM | CN | CB | CC | | |
| | | | | | | | | | | | OVER 10UUF | 10UUF OR LESS | CC |
| BLACK | 0 | 1 | NONE | | A | | | 20 | 20 | 20 | 20 | 2 | ZERO |
| BROWN | 1 | 10 | 1 | B | E | B | W | | | | 1 | | −30 |
| RED | 2 | 100 | 2 | C | H | | X | 2 | | 2 | 2 | | −80 |
| ORANGE | 3 | 1,000 | 3 | D | J | D | | | 30 | | | | −150 |
| YELLOW | 4 | 10,000 | 4 | E | P | | | | | | | | −220 |
| GREEN | 5 | | 5 | F | R | | | | | | 5 | 0.5 | −330 |
| BLUE | 6 | | 6 | | S | | | | | | | | −470 |
| PURPLE (VIOLET) | 7 | | 7 | | T | W | | | | | | | −750 |
| GRAY | 8 | | 8 | | | X | | | | | | 0.25 | +30 |
| WHITE | 9 | | 9 | | | | | | | | 10 | 1 | −330(±500) [3] |
| GOLD | | 0.1 | | | | | | 5 | | 5 | | | +100 |
| SILVER | | 0.01 | | | | | | 10 | 10 | 10 | | | |

1. LETTERS ARE IN TYPE DESIGNATIONS GIVEN IN MIL-C SPECIFICATIONS.
2. IN PERCENT, EXCEPT IN UUF FOR CC-TYPE CAPACITORS OF 10 UUF OR LESS.
3. INTENDED FOR USE IN CIRCUITS NOT REQUIRING COMPENSATION.

STD-CI

*Figure 23. Capacitor color code marking.*

# APPENDIX I
# REFERENCES

Following is a list of references which are applicable and available to the field and depot repairman of Radio Set AN/GRC–26(*).

TM 11–257 ——— Frequency Shift Exciters O–39/TRA–7, O–39A/TRA–7, O–39B/TRA–7, and O–39C/TRA–7.
TM 11–333 ——— Telephones EE–8, EE–8–A, and EE–8–B.
TM 11–352 ——— Printer TG–7–A and Teletypewriters TG–7–B and TG–37–B, and TT–55/MGC.
TM 11–486–6 ——— Electrical Communications Systems Engineering, Radio.
TM 11–666 ——— Antennas and Radio Propagation.
TM 11–826 ——— Radio Transmitter BC–610–E, –F, –G, –H, and –I, and Transmitter T–213/GRC–26 and Antenna Tuning Units BC–939–A and –B.
TM 11–854 ——— Radio Receiver R–388/URR.
TM 11–904 ——— Power Units PE–95–A, –B, –C, –F, –G, –H, –I, and –K
TM 11–957 ——— Rectifier RA–87.
TM 11–957A ——— Rectifier RA–87–A.
TM 11–1214 ——— Oscilloscope OS–8A/U.
TM 11–2062 ——— Test Set I–142, I–142–A, I–142–B and Telephone Test Set AN/PTM–6.
TM 11–2201 ——— Reperforator Teletypewriter Sets TC–16 and TC–17 (including Reperforator Transmitters TT–26–A and TG–26–B, and Perforator Transmitter TT–56/MGC).
TM 11–2208 ——— Test Set TS–2/TG, TS–2A/TG, TS–2B/TG and TS–2C/TG (Teletypewriter Signal Distortion).
TM 11–2217 ——— Distortion Test Set TS–383/GG and TS–383A/GG.
TM 11–2513 ——— Test Set I–193–A, I–193–B, and I–193–C.
TM 11–2661 ——— Electron Tube Test Set TV–2/U and TV–2A/U.
TM 11–2684 or TM 11–2684A ——— Audio Oscillator TS–382(*)/U.
TM 11–5054 ——— Speech Amplifier BC–614–E, –F, –H, and –I.
TM 11–5062 ——— Frequency Shift Converter CV–182/GRC–26A, CV–182A/GRC–26A, and CV–182B/GRC–26A, and Power Supplies PP–712/GRC–26A and PP–712A/GRC–26A.
TM 11–5083 ——— Electron Tube Test Set TV–7/U, TV–7A/U, and TV–7B/U.
TM 11–5094 ——— Frequency Meter AN/URM–79 and AN/URM–82.
TM 11–5097 ——— Spectrum Analyzer TS–723A/U.
TM 11–5120 ——— Frequency Meter AN/URM–32.
TM 11–5132 ——— Electronic Voltmeter ME–30B/U and Voltmeter, Meter ME–30A/U.
TM 11–5511 ——— Electronic Multimeter TS–505/U.
TM 11–5511A ——— Electronic Multimeter TS–505A/U and TS–505B/U, and Multimeters TS–505C/U and TS–505D/U.

TM 11–5551 ----------Rf Signal Generator Set AN/URM–25.
TM 11–5820–202–10 ----------Radio Sets AN/GRC–26A, AN/GRC–26B, and AN/GRC–26C, Operator's Manual.
TM 11–5820–202–20 ----------Radio Sets AN/GRC–26A, AN/GRC–26B, and AN/GRC–26C, Organizational Maintenance, Second Echelon.

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[AG 413.44 (27 Feb 59)]

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*NG:* State AG (3); units—same as Active Army except allowance is one copy to each unit.

*USAR:* None.

For explanation of abbreviations used, see AR 320–50.



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